SEE
FOLLOWING
NOTE

VOIR
NOTE
CI-APRÈS

APPENDICES NUMBER 2 HAVE BEEN
OMITTED FROM THIS FICHE BECAUSE IT IS
OF POOR REPRODUCTIVE QUALITY

- - - - - - - - - - - - - - - - - - - -

L'APPENDICES NUMÉRO 2 A ÉTÉ
OMIS DE CETTE FICHE ÉTANT DONNÉ SA
PIÈTRE QUALITÉ DE REPRODUCTION

Energy in Québec

1988 EDITION

Québec

90-01666/

ENERGY IN QUÉBEC, 1988 EDITION

ERRATA

APPENDIX 2

1987 ENERGY BALANCE SHEET

TABLE A — RESOURCES

II — SECONDARY ENERGY

- Line 2a: should read 1,942,000 barrels under "Diesel fuel"
- Line 2b: should read 108,900 barrels under "Diesel fuel"
- Line 2g: should read 4,461,300 barrels under "Petroleum coke"

TABLE C — CONSUMPTION

- The data for kerosene, light fuel oil and heavy fuel oil given in line 1 (Residential sector) should appear in line 1a (residences) and the data for gasoline, kerosene, diesel fuel, light fuel oil and heavy fuel oil given in line 1a (residences) should appear in line 1b (farms).
- Line 1c: should read 24,022,300 10^3 pi^3 under "Natural gas"
- Line 2b: should read 1,989,800 barrels under "Gasoline"
- Line 2b: should read 40,606,800 10^3 pi^3 under "Natural gas"
- Line 3a: should have a parenthesis before (448,600) under "Propane"
- Line 5b: should read — 5,600 barrels under "Petroleum coke"
- Line 5b: should read 0 short ton under "Coal"
- Line 6: should read 8,412,200 barrels under "Heavy fuel oil"

ENERGY IN QUÉBEC

1988 EDITION

This document was compiled by the Direction générale de la planification, Secteur énergie, and published by the Direction des communications of the ministère de l'Énergie et des Ressources.

CONTENT

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Last September, the Government made a public statement of its energy policy, a policy for the 1990's whose dominant theme is "Energy, the driving force of economic development".

In this new policy, the Government clearly states its intention of utilizing all forms of energy to stimulate economic development and to support regional development. To begin with, Québec can draw from abundant hydroelectric resources; it is of paramount importance to maximize the utilization of these. Already, the development of a potential of 18,000 megawatts is economically feasible and over 80% of the benefits from the considerable investments involved will fall to the industries and workers here.

But a strategy focussed on economic development also necessitates the putting in place of the means required to provide a secure supply of all forms of energy at competitive prices for all categories of consumers. For industries, access to Québec's electricity or to Canadian hydrocarbonic resources, at a good price, is a major factor in investment decisions. For all consumers, whether big or small, the market forces will adapt most appropriately to the needs of everyone through the interplay of competition in the energy industry.

However, in the 1990's, Québec will have to continue more than ever to "master its energy," in other words to consume it efficiently while protecting the environment as well as the quality of life. This is a challenge that must be faced by everyone, individually and collectively. It is also a challenge to which the Government intends to devote greater research and development efforts over the coming years.

Energy in Québec, 1988 Edition is an excellent tool with which to gain an awareness of the Québec energy scene over the past twenty years as well as to open a window on the Québec energy scene of tomorrow. It is my sincere hope that this document will provide each of you with the information that will enable you to understand and follow the challenges facing us in the 1990's.

John Ciaccia

Minister of Énergie et Ressources du Québec
JOHN CIACCIA

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1987 Energy Balance Sheet (Table)

PREFACE

In a single document, **Energy In Québec** compiles all the essential statistical data on Québec's energy sector. By publishing this information annually, the ministère de l'Énergie et des Ressources aims at providing up-to-date, dependable and operational data concerning a key area of economic activity. Statistical information is accompanied by analyses of the outstanding facts and trends of the past year.

The first half of this publication deals with the Québec energy sector in general. It includes statistical data and information showing the developments in total energy demand and energy distribution according to consumption sector, as well as the share claimed by each form of energy on Québec's energy market. It also contains a comparison between Québec's energy consumption and that of the rest of Canada and certain OECD countries; the relative efficiency of energy supply systems in Québec and Ontario; changes in energy prices; and an evaluation of the economic impact of the energy sector. An effort was made to provide data that allow a quantitative assessment of Québec's energy policy. Thus, specific information focuses on Québec's electricity exports, on price developments in energy markets, on the characteristics of demand and on energy economies.

The second half of the document deals with the various energy industries, grouped according to the form of energy concerned (electricity, natural gas, oil and alternative energy sources). An attempt has been made to give the most complete picture possible of each aspect of these industries, by providing a table of all the activities involved, from production to consumption.

To ensure greater coherence and easier reading, the first two chapters of the first half have been recast with respect to earlier editions. This document also includes new data concerning energy consumption adjusted for variations in weather. Moreover, in the second half dealing with the energy industries, greater emphasis has been placed on electricity, whose greater role is one of the characteristics of the recent evolution of the Québec energy sector.

Technical data specifically related to the 1986 energy balance sheet are provided in an appendix. They include statistics on the energy supply structure of Québec's economy and statistics on the distribution of energy per consumption sector. This assessment is presumed final and should not need to be updated for the next edition.

ENERGY IN QUÉBEC: PAST DEVELOPMENT AND CURRENT CHARACTERISTICS

1. ENERGY CONSUMPTION

TOTAL ENERGY CONSUMPTION

In 1987, Québec's total energy consumption (excluding alternative energy sources) reached 30.1 million toe, which represents an increase of 0.7% over 1986. This is a very slight increase, compared to the strong growth of Québec's gross domestic product, which reached 5.2% during the same period.

Table 1.1 shows that consumption per thousand dollars of output continued its downward trend, which has prevailed almost without interruption for nearly fifteen years. This drop in the quantity of energy consumed per unit production value reflects the marked improvement in the energy efficiency of Québec's production system: between 1971 and 1987, Québec's energy consumption fell from 0.55 toe to 0.35 toe per thousand production dollars, a drop of more than a third of the energy content per unit production value. Thus, the level of total energy consumption reached in 1987 is barely higher than the consumption recorded in 1972, for a gross domestic product that is 55% higher in constant dollars.

Table 1.1

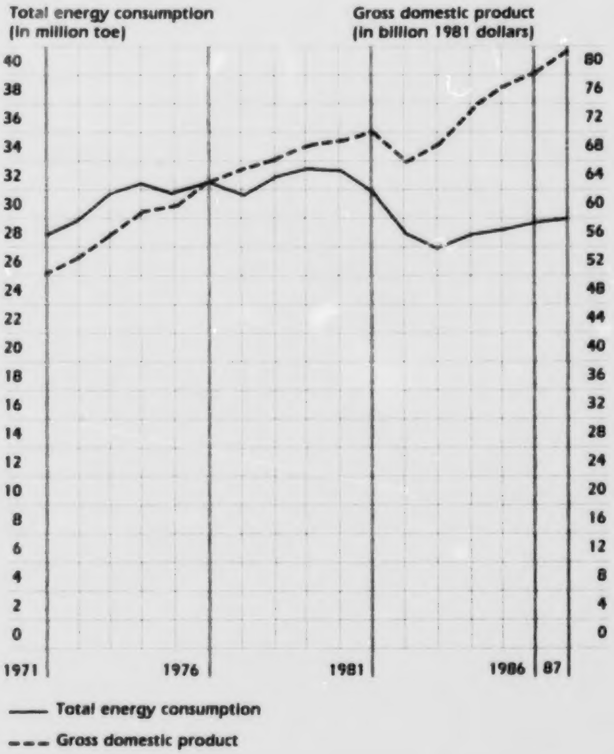
TOTAL NET ENERGY AVAILABLE FOR CONSUMPTION 1971-1987

Years	Total consumption in toe	Per capital consumption in toe	Consumption per thousand dollars of output in toe[1]
1971	28,702,195	4.76	0.55
1972	29,979,785	4.95	0.55
1973	31,949,325	5.26	0.55
1974	32,731,935	5.35	0.54
1975	31,984,402	5.18	0.52
1976	32,688,532	5.24	0.51
1977	31,839,277	5.07	0.48
1978	33,114,589	5.26	0.49
1979	33,561,921	5.29	0.49
1980	33,484,718	5.24	0.48
1981	32,045,479	4.98	0.45
1982	29,047,496	4.48	0.43
1983	28,143,387	4.32	0.40
1984	28,954,504	4.42	0.39
1985	29,331,200	4.46	0.38
1986	29,898,100	4.51	0.37 rd
1987	30,091,928	4.52	0.35 pd

pd: preliminary data
rd: revised data
1. Output value is in 1981 constant dollars.

Graph 1.1

PROGRESS IN QUÉBEC'S ENERGY CONSUMPTION AND ECONOMIC GROWTH 1971-1987



ENERGY CONSUMPTION BY FORM

Since the early 1970s, rapid changes have altered the share of each form of energy in Québec's energy consumption. There has been a significant reduction in the share of oil, in favor of natural gas, electricity, and alternative energy sources. For conventional energy forms, these same tendencies were at least partially maintained in 1987. Developments in the consumption of alternative energy sources are studied in greater depth in Chapter 9.

For 1987, Québec's consumption by form of energy (excluding alternative energy sources) was distributed as follows: 42.1% of total consumption for oil (compared to 43.6% in 1986), 41.7% for electricity (40.2% in 1986), 14.8% for natural gas (14.9% in 1986) and 1.4% for coal (1.3% in 1986).

In one year, oil lost 1.5 points in Québec, with consumption decreasing by 2.8%. It remains the most consumed form of energy in this province, but the gap which separates it from electricity has narrowed considerably. This point spread is now only 0.4 percentage points in terms of overall energy consumption. This was the first time since 1952 that the share of oil in meeting Québec's energy requirements reached this level. During the intervening years, oil has represented up to 74% of Québec's energy consumption. The decrease in oil consumption has also been spectacular in terms of absolute value: the level of consumption has dropped by more than 45% since 1973.

Québec has become considerably less dependent on oil because of the rapid increase in electricity and natural gas consumption. Electricity consumption continued to grow in 1986, while natural gas consumption decreased slightly, as did the share of this energy form in Québec's overall energy consumption. The share of electricity in overall energy consumption rose by 1.5 percentage points, and by 4.6% in terms of absolute value. Conversely, the share of natural gas seems to have come to a certain standstill for the second straight year, with consumption in Québec reduced by 0.2%, while the share of natural gas in overall energy consumption was reduced by 0.1 percentage points. In all, natural gas and electricity met more than half of Québec's energy requirements (56.5%) in 1987, compared to only one third in 1979 and one quarter in 1971.

One of the major developments of the last ten years — the shift in the form of energy sued for residential heating — can be seen very clearly in a more in-depth look at the residential sector. The percentage of housing units using petroleum products as the main heating source dropped from 82.9% in 1971 to 22.7% in 1987. Conservely, during the same period, the proportion of housing units using electricity climbed from 7.0% to 63.6%, while those using natural gas rose from 6.7% to 9.6%. In 1987, almost 1,608,000 housing units were heated mainly by electricity, compared to less than 400,000 in 1976 and only 100,000 in 1971.

The reduction of the share of oil in energy consumption and the increased penetration of electricity have significantly reinforced Québec's energy self-sufficiency. The degree of energy self-sufficiency of the Québec economy, calculated by applying the OECD's conversion system, has once more increased in 1987 to reach 79%, compared to 51% in 1975. With the addition of fossil fuels from the rest of Canada to the electricity available in Québec, Québec's overall energy self-sufficiency stood at 96% in 1987, compared to 56% in 1975. Since 1976, Québec has in effect benefited from greater access to western Canada's fossil fuels thanks to the penetration of natural gas and to the replacement by Canadian oil of part of the oil purchased on the international market.

Table 1.2

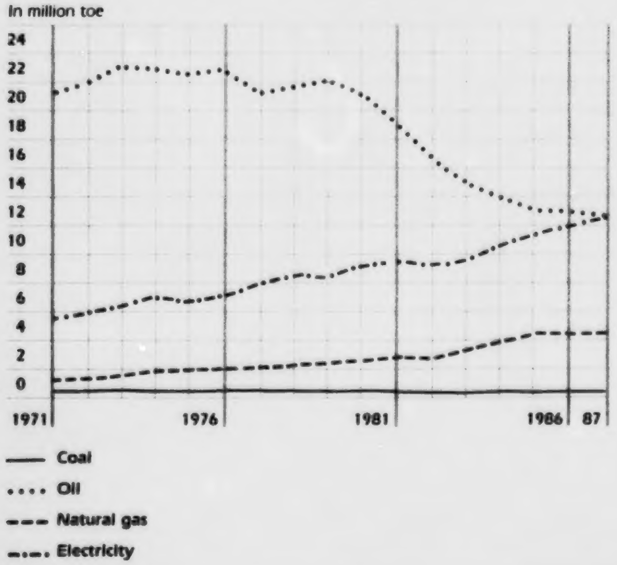
TOTAL NET ENERGY AVAILABLE FOR CONSUMPTION, BY FORM
1971-1987

	Coal[1]		Oil[2]		Gas[3]		Electricity	
Year	**toe**	**%**	**toe**	**%**	**toe**	**%**	**toe**	**%**
1971	580,660	2.02	21,200,732	73.86	1,370,206	4.78	5,550,597	19.34
1972	554,578	1.85	21,945,925	73.20	1,451,545	4.84	6,027,737	20.11
1973	626,028	1.96	23,273,569	72.84	1,584,601	4.96	6,465,127	20.24
1974	547,229	1.67	23,084,257	70.52	1,962,677	6.00	7,137,772	21.81
1975	478,590	1.50	22,609,478	70.69	2,023,409	6.32	6,872,925	21.49
1976	553,982	1.70	22,987,074	70.32	2,044,274	6.25	7,103,202	21.73
1977	500,571	1.57	21,196,148	66.57	2,150,190	6.76	7,992,368	25.10
1978	561,578	1.70	21,627,616	65.31	2,350,465	7.10	8,574,930	25.89
1979	473,111	1.41	22,173,212	66.07	2,470,467	7.36	8,445,131	25.16
1980	515,359	1.54	21,285,419	63.57	2,560,580	7.65	9,123,360	27.24
1981	413,722	1.29	19,218,141	59.97	2,858,504	8.92	9,555,112	29.82
1982	395,407	1.36	16,646,724	57.31	2,686,549	9.25	9,318,816	32.08
1983	353,811	1.26	14,981,335	53.23	3,270,471	11.62	9,537,770	33.89
1984	401,910	1.39	14,121,602	48.77	3,794,170	13.10	10,636,822	36.74
1985	360,818	1.23	13,081,738	44.60	4,470,701	15.24	11,417,964	38.93
1986	395,363	1.32	13,043,460	43.63	4,458,869	14.91	12,000,409	40.14
1987	412,804	1.37	12,674,433	42.12	4,452,464	14.80	12,552,227	41.71

1. Including coke and coke-oven gas.
2. Includes oil and the following products: gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke, propane, butane and still gas.
3. Natural gas.

Graph 1.2

CONSUMPTION BY FORM OF ENERGY



Graph 1.3

SHARE OF TOTAL ENERGY CONSUMPTION, BY FORM

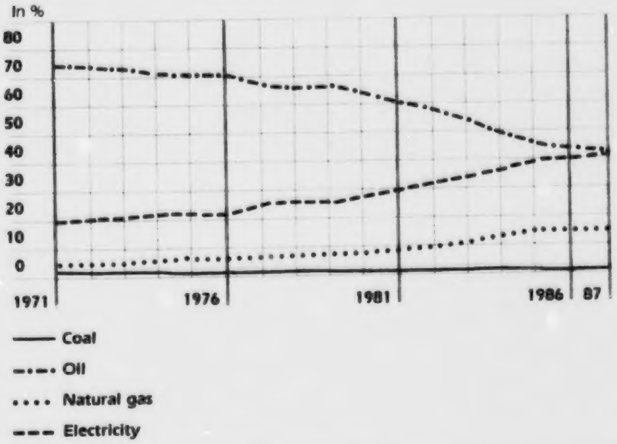


Table 1.3

DISTRIBUTION OF HOUSING UNITS BY MAIN FORM OF ENERGY USED FOR HEATING

1971-1987

In number of housing units

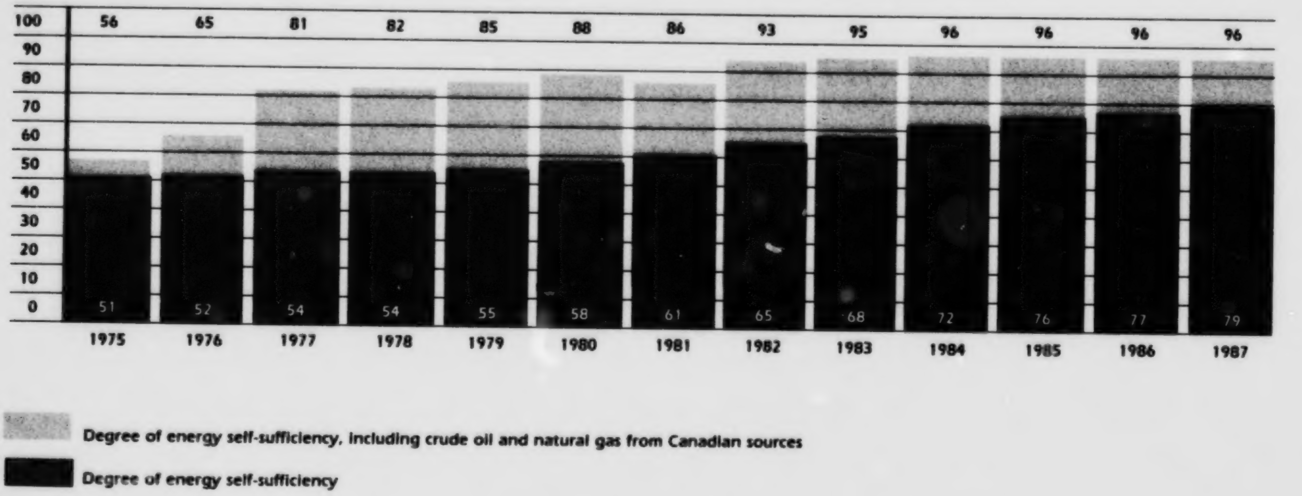
	Oil		Natural gas		Electricity		Wood		Other[1]		Total number of units	
Year	thousands	%	thousands	%	thousands	%	thousands	%	thousands	%	thousands	%
1971	1,288	82.85	123	7.72	111	6.97	64	4.02	7	0.44	1,593	100.00
1972	1,343	81.94	104	6.34	132	8.05	55	3.36	5	0.31	1,639	100.00
1973	1,337	79.25	116	6.88	175	10.37	53	3.14	6	0.36	1,687	100.00
1974	1,354	77.73	120	6.89	214	12.28	48	2.76	6	0.34	1,742	100.00
1975	1,346	75.24	113	6.32	277	15.48	43	2.40	10	0.56	1,789	100.00
1976	1,314	70.57	128	6.88	373	20.03	41	2.20	6	0.32	1,862	100.00
1977	1,260	65.73	140	7.30	463	24.15	41	2.14	13	0.68	1,917	100.00
1978	1,220	62.79	128	6.59	543	27.94	47	2.42	5	0.26	1,943	100.00
1979	1,221	60.78	123	6.12	627	31.21	38	1.89			2,009	100.00
1980	1,099	53.48	132	6.42	774	37.67	50	2.43			2,055	100.00
1981	1,049	49.41	141	6.64	882	41.55	51	2.40			2,123	100.00
1982	986	45.15	170	7.78	956	43.77	72	3.30			2,184	100.00
1983	906	40.56	191	8.55	1,061	47.49	76	3.40			2,234	100.00
1984	805	34.71	196	8.45	1,214	52.35	104	4.49			2,319	100.00
1985	679	28.58	198	8.33	1,390	58.50	96	4.04	13	0.55	2,376	100.00
1986	610	24.79	277	11.26	1,420	57.70	147	5.97	7	0.28	2,461	100.00
1987	575	22.73	242	9.57	1,608	63.56	90	3.56	15	0.59	2,530	100.00

1. Includes coal, coke and bottled gas.
Source: Statistics Canada, catalogue 64-202.

Graph 1.4

EVOLUTION OF QUÉBEC'S ENERGY SELF-SUFFICIENCY

In %



ENERGY CONSUMPTION BY SECTOR

Analysis of energy consumption by sector, where consumption is expressed on the basis of standard socio-economic variables, shows that in the residential sector energy consumption per household decreased significantly in 1987, prolonging a tendency observed since 1973 (with the exception of 1985). Over a 14-year period, energy consumption per household in Québec fell by 40%. Per-unit consumption by automobiles and per-unit consumption in the industrial and commercial sectors also fell in 1987, but by smaller margins.

Examination of energy consumption by sector reveals that, in 1987, the relative importance of the residential and commercial sectors decreased in favor of the transportation and commercial sectors. The industrial sector strengthened its position as the largest energy consumer, with 37.1% of total consumption, while the shares of the residential, transportation and commercial sectors were 20.4%, 26.7% and 15.8%, respectively.

A further breakdown of energy consumption by sector allows identification of some of the major uses of energy in Québec. Thus, in 1987, industries in the iron and steel, smelting and refining, pulp and paper, and forestry categories accounted for 59.8% of the industrial sector's energy consumption and 22.2% of overall energy consumption. Road transportation accounted for almost four fifths of energy consumption in the transportation sector and 21.7% of overall energy consumption.

Table 1.4

ENERGY CONSUMPTION BY SECTOR[1] ACCORDING TO TEST SOCIOECONOMIC VARIABLES
1971-1987

Year	Residential sector[2] (in toe per household)	Commercial sector[3] (in toe per thousand dollars of output)	Transportation sector[4] (in toe per vehicle)	Industrial sector[5] (in toe per thousand dollars of output)
1971	4.18	0.14 rd	2.53	0.50 rd
1972	4.21	0.14 rd	2.39	0.51
1973	4.06	0.13	2.58	0.53 rd
1974	4.17	0.12 rd	2.40	0.55 dr
1975	4.16	0.10 rd	2.45	0.53 rd
1976	4.16	0.12 rd	2.37	0.46 rd
1977	3.76	0.11 rd	2.23	0.45 rd
1978	3.73	0.10 rd	2.40	0.48 rd
1979	3.74	0.10	2.47	0.48 rd
1980	3.64	0.10	2.37	0.50 rd
1981	3.31	0.10 rd	2.03	0.48 rd
1982	3.09	0.10 rd	1.74	0.47 rd
1983	2.78	0.10	1.58	0.45 rd
1984	2.62	0.10	1.58	0.44 rd
1985	2.70	0.08	1.59 rd	0.44 rd
1986	2.64	0.09	1.52 rd	0.43 rd
1987	2.43	0.08 pd	1.51	0.41 pd

pd: preliminary data
rd: revised data
1. Excluding alternative energy sources.
2. Energy consumption of the residential sector according to the number of households.
3. Energy consumption of the commercial sector according to the gross domestic product of the tertiary sector, in 1981 constant dollars.
4. Gasoline and diesel fuel oil consumption according to the number of vehicles on the road.
5. Energy consumption of the industrial sector according to the gross domestic product of the industrial sector, in 1981 constant dollars.

Table 1.5

DISTRIBUTION OF TOTAL ENERGY CONSUMPTION BY SECTOR[1]
1971-1987

	Residential sector		Commercial sector		Transportation sector		Industrial sector	
Year	toe	%	toe	%	toe	%	toe	%
1971	6,656,604	23.52	4,649,740	16.43	7,859,227	27.66	9,140,936	32.29
1972	6,917,822	23.27	4,756,787	16.00	8,344,001	28.07	9,710,677	32.66
1973	6,851,837	21.70	4,647,122	14.71	9,414,439	28.81	10,666,587	33.78
1974	7,264,013	22.37	4,634,732	14.28	9,047,604	27.87	11,517,422	35.48
1975	7,449,874	23.52	3,993,797	12.61	9,332,098	29.46	10,898,430	34.41
1976	7,740,241	23.82	5,099,644	15.70	9,690,147	29.83	9,957,386	30.65
1977	7,208,392	22.63	4,821,372	15.13	9,721,990	30.51	10,109,068	31.78
1978	7,292,479	22.16	4,592,448	13.96	9,948,820	30.24	11,066,585	33.64
1979	7,536,892	22.70	4,412,743	13.29	10,068,063	30.32	11,184,738	33.69
1980	7,503,330	22.31	4,540,067	13.50	10,262,693	30.51	11,325,777	33.68
1981	7,045,444	22.01	4,715,899	14.73	9,204,393	28.75	11,048,829	34.51
1982	6,757,203	23.34	4,675,263	16.15	7,721,795	26.68	9,794,134	33.83
1983	6,222,609	22.18	4,707,473	16.78	7,374,463	26.29	9,750,437	34.75
1984	6,095,301	21.09	4,777,995	16.53	7,568,267	26.18	10,464,864	36.20
1985	6,418,411	21.98	4,257,266	14.58	7,716,922	26.43	10,807,787	37.01
1986	6,485,095	21.73	4,904,945	16.44	7,756,065	25.99	10,692,456	35.84
1987	6,151,854	20.43	4,746,329	15.77	8,039,900	26.71	11,164,297	37.09

1. Excluding other uses.

Graph 1.5

SHARE OF TOTAL ENERGY CONSUMPTION BY SECTOR
1987

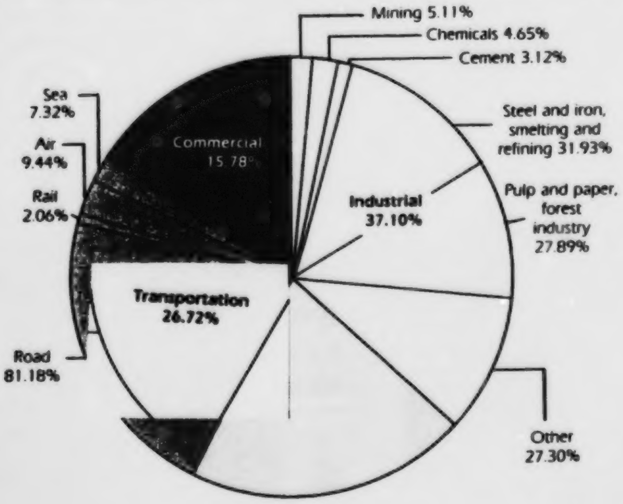


Table 1.6

ENERGY CONSUMPTION IN THE TRANSPORTATION SECTOR
1971-1987

Year	Road transportation		Rail transportation		Shipping		Air transportation	
	toe	%	toe	%	toe	%	toe	%
1971	5,750,333	73.16	428,293	5.45	930,177	11.84	750,423	9.55
1972	6,143,648	73.63	409,387	4.90	1,015,939	12.18	775,024	9.29
1973	6,991,842	74.27	425,828	4.52	1,135,047	12.06	861,713	9.15
1974	6,954,147	76.86	462,894	5.12	771,244	8.52	859,311	9.50
1975	7,452,122	79,85	342,595	3.67	623,999	6.69	913,373	9.79
1976	7,737,788	79.85	285,377	2.95	811,225	8.37	855,751	8.83
1977	7,853,980	80.78	295,955	3.04	755,843	7.77	818,521	8.41
1978	7,968,116	80.09	258,485	2.60	896,415	9.01	825,804	8.30
1979	8,048,717	79.95	276,040	2.74	1,015,754	10.09	727,333	7.22
1980	7,964,515	77.61	271,238	2.64	1,337,389	13.03	689,552	6.72
1981	7,147,520	77.65	274,101	2.98	1,175,905	12.78	606,867	6.59
1982	5,937,005	76.89	222,614	2,88	1,015,161	13.15	547,015	7.08
1983	5,768,612	78.26	230,754	3.13	828,879	11.25	542,740	7.36
1984	5,902,269	77.99	259,292	3.43	784,718	10.37	621,596	8.21
1985	6,127,841	79.40	260,972	3.38	660,301	8.56	668,784	8.66
1986	6,282,555	81.00	182,509	2.35	623,922	8.04	668,807	8.61
1987	6,526,791	81.18	165,622	2.06	588,521	7.32	758,967	9.44

N.B.: These figures have been rounded off. Consequently, the totals given may differ from those in the previous table.

Table 1.7

TOTAL ENERGY CONSUMPTION BY CERTAIN INDUSTRIES
1971-1984

Year	Mining		Papers and related products[1]		Ore processing industry[1]		Nonmetallic mineral products		Chemical industry		Total for mining and manufacturing industries[2]
	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe
1971	644.77	7.19	3,095.95	34.52	2,661.83	29.68	667.74	7.44	631.71	7.04	8,969.36
1972	616.32	6.74	3,054.49	33.40	2,591.14	28.33	857.58	9.38	631.93	6.91	9,144.82
1973	782.43	8.62	2,867.49	31.61	2,691.82	29.67	905.54	9.97	599.83	6.61	9,072.46
1974	919.42	9.46	3,120.63	32.12	3,013.41	31.01	950.31	9.78	575.10	5.92	9,717.07
1975	747.54	8.43	2,702.13	30.48	2,711.24	30.59	860.07	9.70	549.79	6.20	8,863.81
1976	975.92	11.56	3,038.69	36.00	2,045.42	24.23	740.25	8.77	595.43	7.05	8,441.47
1977	987.37	10.92	3,024.60	33.46	2,791.26	30.88	690.18	7.63	644.29	7.13	9,040.44
1978	861.95	8.86	3,185.98	32.76	3,089.59	31.77	760.30	7.82	689.50	7.09	9,725.19
1979	1,125.05	11.66	3,231.06	33.48	2,727.80	28.26	844.70	8.75	708.95	7.34	9,652.12
1980	989.75	9.74	3,105.24	30.54	3,506.32	34.49	cd		726.81	7.15	10,166.54
1981	848.25	8.36	3,143.44	30.97	3,420.91	33.71	678.08	6.68	cd		10,148.66
1982	624.84	6.80	2,808.65	30.56	2,678.18	29.14	561.39	6.11	714.27	7.77	9,190.00
1983	588.92	7.50	2,647.66	33.72	2,466.48	31.41	394.54	5.02	430.86	5.49	7,851.64
1984	643.23	7.97	2,717.19	33.65	2,614.62	32.38	cd.		384.53	4.76	8,075.47

cd: confidential data

[1] Includes an estimate of producer-consumer electricity.

[2] Excluding alternative energy sources such as wood and steam.

Sources: Statistics Canada, catalogues 57-208, 57-506 and data compiled by the Direction des études et statistiques of the ministère de l'Energie et des Ressources du Québec.

ENERGY CONSUMPTION ADJUSTED FOR VARIATIONS IN WEATHER

The total energy consumption recorded for a given year depends on the harshness of the weather, since many energy uses (mainly water and space heating) are sensitive to changes in the weather. Since in the medium term the variations cancel each other out in a given region, a weather average can be used. To compare the evolution of the total energy consumption from one year to the next, it might be preferable to eliminate short-term weather factors and to correct the consumption actually observed by estimating the level it would have reached if the weather characteristics of a given hear had been equivalent to the average. This is called "consumption adjusted for variations in weather ».

Thus, for 1987, the mild weather, indicated by a number of degree-days of heating lower than the average, is partly responsible for the very slight increase in the energy consumption observed (+ 0.6%). This consumption rose from 29.9 million toe in 1986 to 30.1 million toe in 1987. By eliminating the weather factor in the annual variations of energy consumption, the comparison between 1986 and 1987 shows a 2.5% theoretical increase of energy consumption. In effect, the consumption data adjusted for variations in weather indicate a total of 29.7 million toe in 1986 and 30.5 million toe in 1987.

Despite this correction, the share of each energy form in Québec's energy consumption for 1987 remains virtually unchanged. In the energy consumption adjusted for variations in weather, the shares of the various energy forms would indeed stand at 42.1% for oil, 41.7% for electricity, 14.9% for natural gaz and 1,3% for coal. Moreover, an analysis of the use of energy by sector indicates that energy uses sensitive to variations in weather are found mainly in the residential and commercial sectors. Following such a correction, the share of the residential sector increases from 20.4% to 20.8% of Québec's energy consumption and that of the commercial sector from 15.8% to 16.1% of total consumption, while the share of the industrial sector drops from 37.1% to 36.7% and that of the transportation sector from 26.7% to 26.4%.

Table 1.8

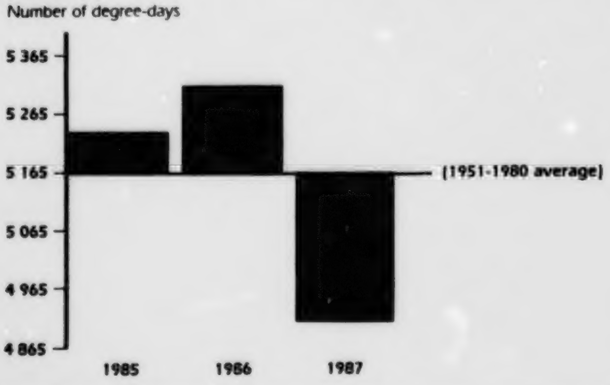
TOTAL ENERGY CONSUMPTION RECORDED AND ADJUSTED FOR VARIATIONS IN WEATHER AND ANNUAL DEGREE-DAYS OF HEATING
1985-1987

	Consumption		Adjusted for variations in weather	
Year	recorded (toe)	adjusted (toe)	Number of degree-days of heating	Spread from average[1]
1985	29,331,220	29,239,230	5,234	+ 69
1986	29,898,101	29,712,039	5,299	+ 134
1987	30,091,928	30,460,597	4,904	− 261

1. Thirty-year average (1951-1980) of annual degree-days of heating: 5,165.

Graph 1.6

SPREAD FROM AVERAGE OF DEGREE-DAYS OF HEATING
1985-1987



2. QUÉBEC ENERGY CONSUMPTION IN PERSPECTIVE

ENERGY CONSUMPTION IN QUÉBEC AND THE REST OF CANADA

In 1987, energy consumption in Québec represented 21.3% of the overall energy consumption in Canada, compared to 37.2% for Ontario and 14.2% for Alberta.

The comparison of consumption in the separate provinces on the basis of standard socio-economic variables puts in sharper perspective the characteristics of Québec's energy demand. Thus, in 1987, per capita energy consumption was lower in Québec than in all of Canada, except the Atlantic provinces. On the other hand, Québec's energy consumption per thousand output dollars was the lowest in Canada, with that of Manitoba and of Ontario. However, these energy consumption indicators, either per capita or per unit production value, strongly depend on the industrial structure of the economy and must therefore be used with caution, since they cannot strictly be classified as energy efficiency indicators.

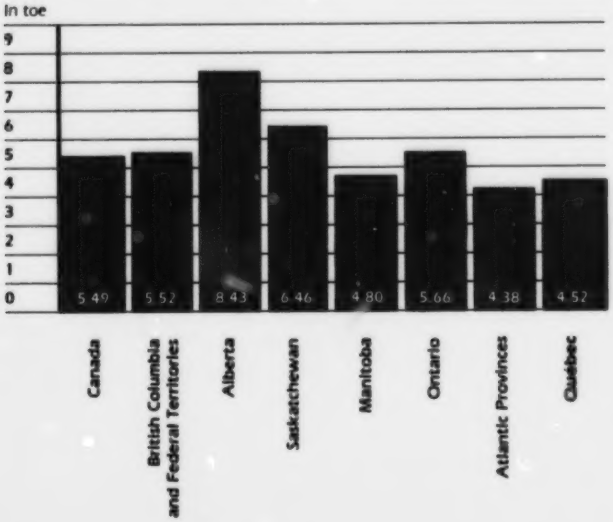
Comparison reveals that the structure of energy consumption in Québec differs significantly from that in the other Canadian provinces. Electricity plays the most important role in Québec (41.7% of energy consumption in 1987, as compared to 25.1% for the rest of Canada). Conversely, and despite its current market penetration, natural gas remains a neglected form of energy in Québec, in comparison to its use by the other provinces. In 1987, natural gas accounted for 14.8% of the total energy consumption in Québec, compared to 33.6% in Ontario, 46.2% in Alberta and 28.5% in Canada as a whole. Only the Atlantic provinces consume less natural gas than Québec.

As regards oil, the structure of energy consumption in Québec is very similar to that of Canada as a whole. In recent years, Québec has significantly reduced its oil consumption; it now consumes slightly less oil than Canada as a whole. Oil now meets 42.1% of Québec's energy requirements and 42.7% of those of Canada overall.

The disparity between energy consumption in Québec and that in the other provinces explains the fact that, with a little more than one fifth of the total energy consumed, Québec was Canada's biggest consumer of electricity in 1987 (35.5% of the total consumption) and the second biggest consumer of oil (21.1% of the total consumption), while it accounted for 11.1% of the total consumption of natural gas — compared to 43.9% for Ontario.

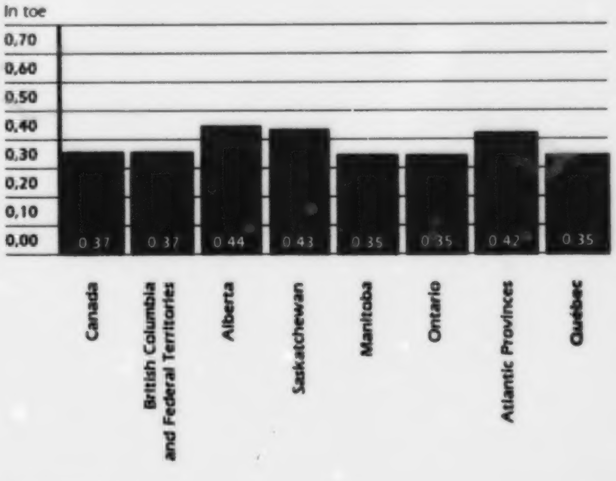
Graph 2.1

PER CAPITA ENERGY CONSUMPTION — QUÉBEC AND OTHER PROVINCES OF CANADA
1987



Graph 2.2

ENERGY CONSUMPTION PER THOUSAND DOLLARS OF OUTPUT[1] — QUÉBEC AND OTHER PROVINCES OF CANADA
1987



[1] In 1981 dollars.

Table 2.1

ENERGY CONSUMPTION IN CANADA AND IN THE PROVINCES — TOTAL NET ENERGY AVAILABLE FOR CONSUMPTION

1987

	Québec		Atlantic Provinces		Ontario		Manitoba	
	toe	%	toe	%	toe	%	toe	%
Coal[1]	412,804	1.37	191,520	1.91	4,440,200	8.46	72,328	1.40
Oil[2]	12,674,433	42.12	7,354,998	73.45	19,223,357	36.60	2,360,086	45.60
Natural gas[3]	4,452,464	14.80	573	0.01	17,595,317	33.55	1,564,362	30.23
Electricity	12,552,227	41.71	2,466,499	24.63	11,241,373	21.39	1,178,574	22.77
Total	30,091,928	100.00	10,013,590	100.00	52,500,247	100.00	5,175,350	100.00

	Saskatchewan		Alberta		British Columbia and Federal Territories		Canada as a whole	
	toe	%	toe	%	toe	%	toe	%
Coal[1]	113,842	1.74	21,545	0.11	91,293	0.55	5,343,532	3.79
Oil[2]	3,009,029	45.97	7,898,125	39.36	7,661,459	46.22	60,181,486	42.69
Natural gas[3]	2,468,912	37.72	9,277,797	46.23	4,753,398	28.67	40,112,823	28.46
Electricity	954,138	14.57	2,869,461	14.30	4,071,181	24.56	35,333,453	25.06
Total	6,545,921	100.00	20,066,928	100.00	16,577,331	100.00	140,971,295	100.00

1. Including coke and coke-oven gas.
2. Including crude oil and the following products: gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke, propane, butane and still gas.
3. Natural gas.

Graph 2.3

ENERGY CONSUMPTION IN THE CANADIAN PROVINCES 1987

In %

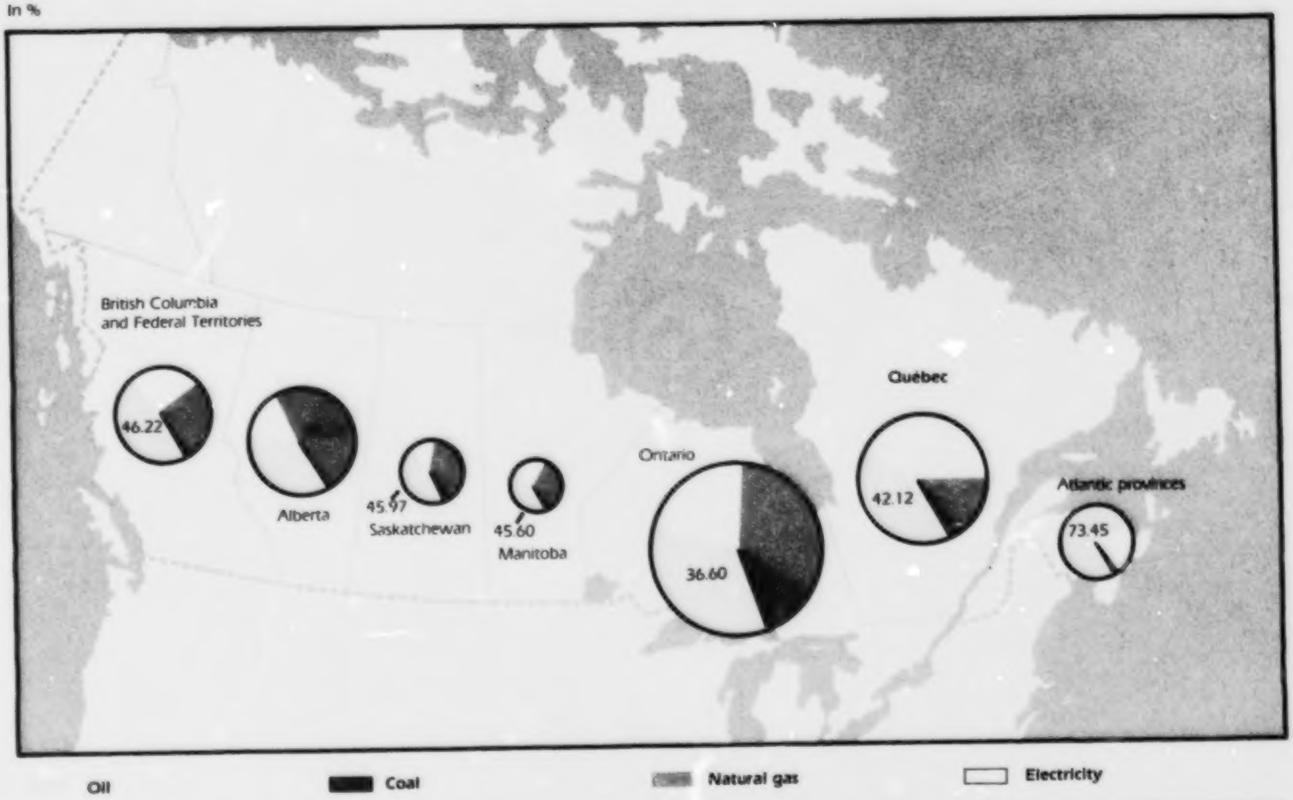

British Columbia and Federal Territories
46.22
Alberta
45.97
Saskatchewan
45.60
Manitoba
Ontario
36.60
Québec
42.12
Atlantic provinces
73.45
Oil
Coal
Natural gas
Electricity

Table 2.2

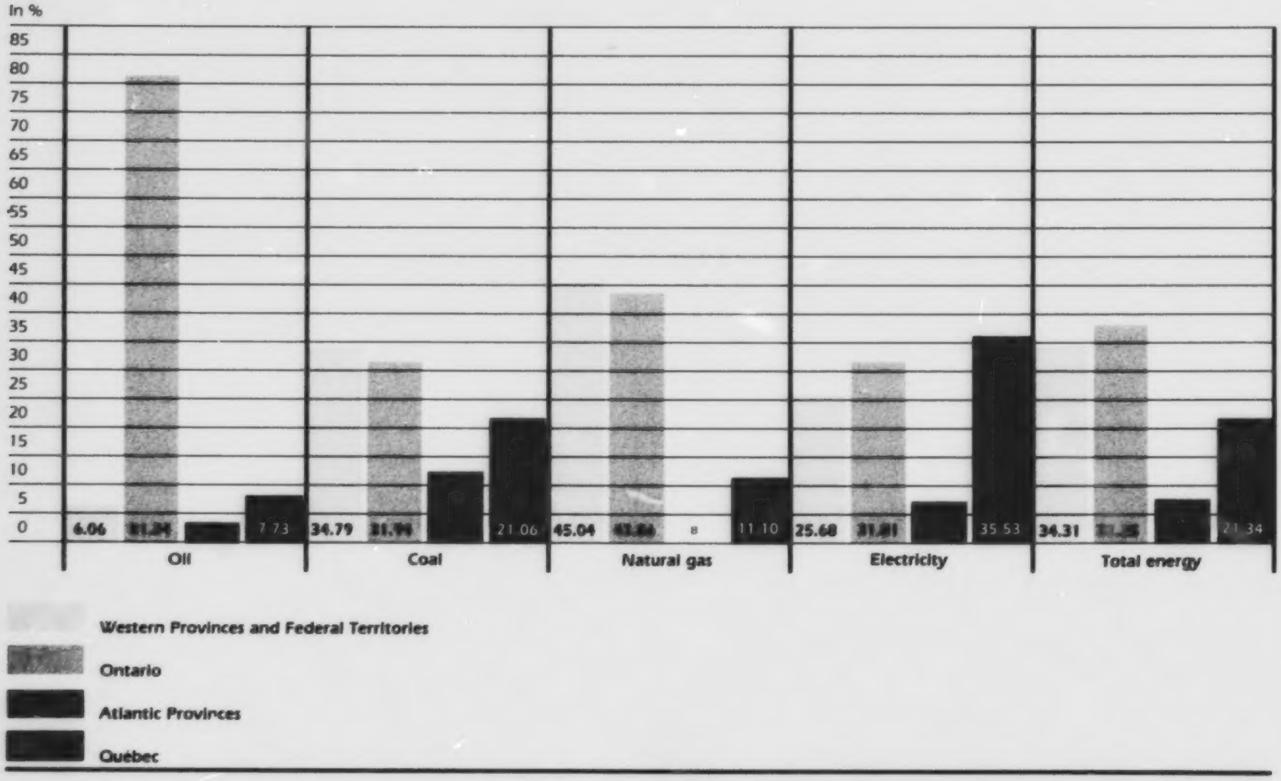
DISTRIBUTION OF TOTAL NET ENERGY AVAILABLE FOR CONSUMPTION, BY PROVINCE AND FORM
1987

	Coal[1]		Oil[2]		Natural gas[3]		Electricity		Total	
	toe	%	toe	%	toe	%	toe	%	toe	%
Québec	412,804	7.73	12,674,433	21.06	4,452,464	11.10	12,552,227	35.53	30,091,928	21.34
Atlantic Provinces	191,520	3.58	7,354,998	12.22	573	r	2,466,499	6.98	10,013,591	7.10
Ontario	4,440,200	83.10	19,223,357	31.94	17,595,317	43.86	11,241,373	31.81	52,500,247	37.25
Manitoba	72,328	1.35	2,360,086	3.94	1,564,362	3.90	1,178,574	3.34	5,175,349	3.67
Saskatchewan	113,842	2.13	3,009,029	5.00	2,468,912	6.15	954,138	2.70	6,545,921	4.64
Alberta	21,545	0.40	7,898,125	13.12	9,277,797	23.13	2,869,461	8.12	20,066,928	14.24
British Columbia and Federal Territories	91,293	1.71	7,661,459	12.73	4,753,398	11.86	4,071,181	11.52	16,577,331	11.76
Canada as a whole	5,343,532	100.00	60,181,487	100.00	40,112,823	100.00	35,333,453	100.00	140,971,295	100.00

1. Including coke and coke oven-gas.
2. Includes crude oil and the following products: gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke, propane, butane and still gas.
3. Natural gas.

Graph 2.4

SHARE OF EACH PROVINCE IN ENERGY CONSUMPTION, BY FORM
1987



ENERGY CONSUMPTION IN QUÉBEC AND OECD COUNTRIES

Québec's energy consumption can also be compared with that of major industrialized countries. In 1986, it can be said that in relative terms Québec was one of the biggest energy consumers. In that year, Québec's energy consumption was in effect equivalent to that of Sweden or Belgium, and represented one eight of Japan's energy consumption, although Québec has a population nineteen times smaller than that of Japan. In spite of the improvements made over the years, per capita energy consumption remained higher in Québec than in most industrialized countries outside North America. Similarly — although this type of comparison does have its limits — it should be noted that Québec's consumption per thousand dollars of output was also higher than that of all the countries with which it was compared, including the United States.

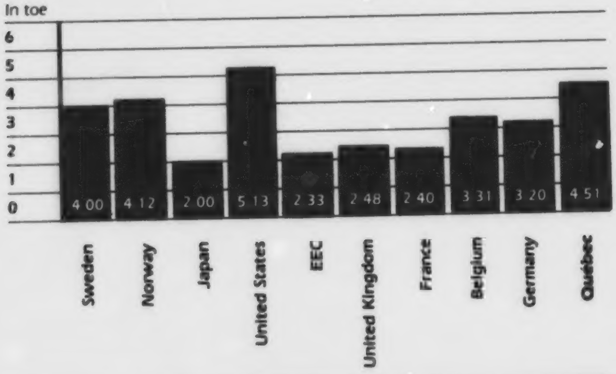
The comparison of the structure of energy consumption in Québec and OECD countries confirms the originality of the Québec situation. This province is one of the industrialized societies where electricity plays the most important role. Among the OECD countries, only Norway and Sweden enjoy a similar situation, with the share of electricity reaching respectively 46.7% and 34.9% of their energy consumption.

In terms of energy self-sufficiency, Québec's situation compares favorably with that of several industrialized countries. The reduced share of oil in overall energy consumption and the increased penetration of electricity have resulted in a significant strengthening of Québec's energy self-sufficiency. Calculated by applying the OECD's conversion method, Québec's energy self-sufficiency stood at 79% in 1987.

In 1986, the last year for which international statistics are available, Québec's energy self-sufficiency was higher than that of Germany, France and Japan, countries which depend extensively on external supplies and whose energy self-sufficiency was 48%, 44% and 20%, respectively. Québec's energy self-sufficiency was also higher than that of Ontario (33%). However, because Québec does not produce a significant amount of primary energy from a source other than hydroelectricity, its energy self-sufficiency is lower than that of the United Kingdom, the U.S. and the rest of Canada, which all produce large amounts of fossil fuels.

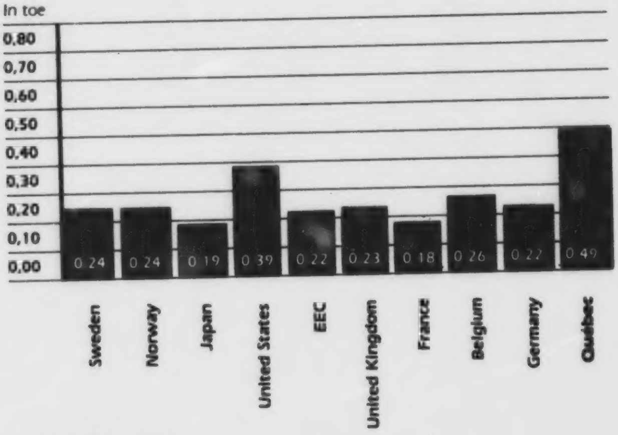
Graph 2.5

PER CAPITA ENERGY CONSUMPTION — QUÉBEC AND MAJOR INDUSTRIALIZED COUNTRIES
1986



Graph 2.6

ENERGY CONSUMPTION PER THOUSAND DOLLARS OF OUTPUT[1] — QUÉBEC AND MAJOR INDUSTRIALIZED COUNTRIES
1986



1. In 1980 US dollars.

Table 2.3

ENERGY CONSUMPTION BY FORM[1] — QUÉBEC AND MAJOR INDUSTRIALIZED COUNTRIES
1986

	Oil		Coal		Natural Gas		Electricity		Other[2]		Total	
	million toe	**%**	**million toe**	**%**	**million toe**	**%**	**million toe**	**%**	**million toe**	**%**	**million toe**	**%**
Sweden	15.41	54.4	1.65	5.8	0.20	0.7	9.89	34.9	1.17	4.2	28.32	100.0
Norway	7.79	47.5	0.93	5.7			7.66	46.7	0.02	0.1	16.40	100.0
Japan	147.25	60.5	32.29	13.3	12.64	5.2	51.20	21.0			243.38	100.0
United States	639.52	54.7	61.44	5.3	272.03	23.2	195.62	16.7	1.58	0.1	1,170.19	100.0
EEC	399.32	53.5	68.96	9.2	158.05	21.2	115.93	15.5	4.35	0.6	746.61	100.0
United Kingdom	60.99	43.3	15.70	11.1	42.54	30.2	21.51	15.3	0.01	0.1	140.75	100.0
France	74.45	56.0	11.28	8.5	24.41	18.4	22.73	17.1			132.87	100.0
Belgium	17.09	52.4	4.59	14.1	6.45	19.8	4.24	13.0	0.22	0.7	32.59	100.0
Germany	107.24	55.2	20.29	10.4	33.56	17.3	30.46	15.7	2.83	1.4	194.38	100.0
Québec	13.04	43.6	0.40	1.3	4.46	14.9	12.00	40.2			29.90	100.0

1. Not including alternative forms of energy (wood, peat moss).
2. Includes heat produced by power plants producing both heat and electricity.

Sources: OECD, **Energy Balances of OECD Countries 1985-1986**, Paris, 1988, and the ministère de l'Énergie et des Ressources du Québec.

Graph 2.7

THE SHARE OF ELECTRICITY IN THE ENERGY CONSUMPTION OF QUÉBEC AND MAJOR INDUSTRIALIZED COUNTRIES
1986

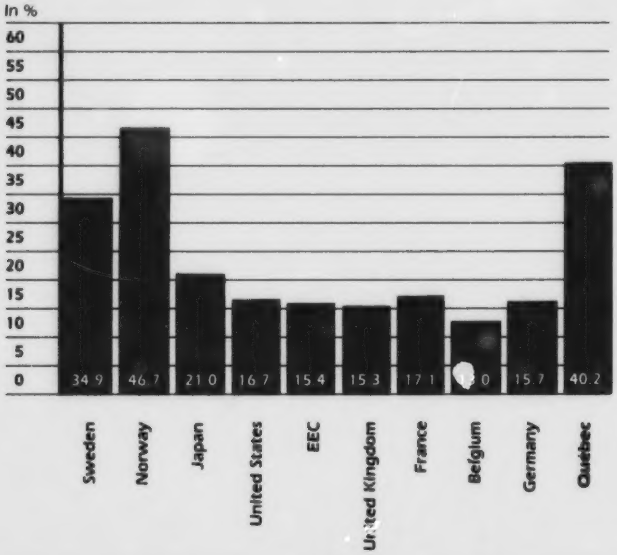


Table 2.4

DEGREE OF ENERGY SELF-SUFFICIENCY IN MAJOR INDUSTRIALIZED COUNTRIES[1]
1986

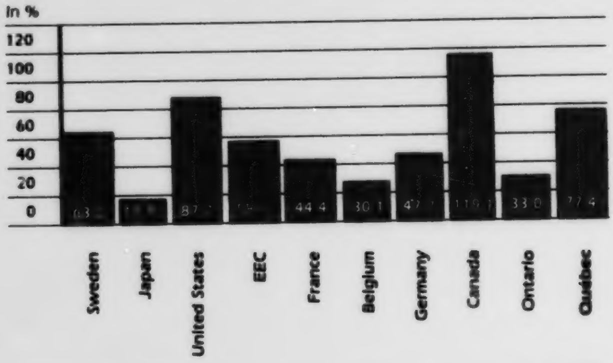
Country or Canadian province	Degree of energy self-sufficiency (%)
Sweden	63.3
Norway	308.1
Japan	19.9
United States	87.7
EEC	58.0
United Kingdom	119.4
France	44.4
Belgium	30.1
Germany	47.7
Canada	119.1
Ontario	33.0
Alberta	366.9
Québec	77.4

1. The degree of energy self-sufficiency was calculated at the level of primary energy (by dividing domestic energy production by energy requirements), taking into account external secondary energy trade. For primary energy, particularly electricity, the OECD conversion rates were applied.

Sources: OECD, **Energy Balances of OECD Countries 1985-1986**, Paris, 1988, and the ministère de l'Énergie et des Ressources du Québec.

Graph 2.8

DEGREE OF ENERGY SELF-SUFFICIENCY IN QUÉBEC AND CERTAIN INDUSTRIALIZED COUNTRIES
1986



3. EFFICIENCY OF THE ENERGY SUPPLY SYSTEM

The preceding chapters described the development of conventional energy consumption in Québec, as a whole, by form and by sector, and compared this evolution with energy consumption in the rest of Canada and certain OECD countries. The characteristics of the energy forms and technologies used for production, transportation and energy consumption as well as the behavior of consumers, all determine the overall efficiency of the energy system.

OVERALL EFFICIENCY OF THE SYSTEM

In 1987, Québec received 31.6 million toe of energy supply (excluding energy from alternative sources), of which 20.9 million toe were actually used — that is, 66% of the original amount. The balance of this energy was lost during production, transformation, transmission and final consumption. This ratio between the amount of energy produced or bought and the amount actually used represents the overall efficiency rate for Québec's energy system. (Details of calculation and methodology are presented under "The Energy Transformation System in Québec," p. 28).

Using the data in Graph 3.1, calculation of the efficiency of Québec's energy transformation system gives the following results: in 1987, the "efficiency rate" — the percentage of available energy which was transformed into useful output — was 87% for coal, 34% for oil, 81% for natural gas and 91% for electricity. For coal, natural gas and oil, efficiency rates are fairly consistent from one country to the next. The low efficiency level registered for oil consumption is due to the low efficiency level (between 20%-23%) of equipment powered by this form of energy in the transportation sector, and to the lower efficiency of equipment powered by petroleum products — as opposed to natural gas or electricity — in the residential and industrial sectors.

Electricity has made Québec's situation unique: the overall efficiency of the electricity sector was over 90%, whereas it was generally less than 50% in the major industrialized countries. This is due to the high proportion of hydroelectricity in Québec. In 1987, losses incurred during production, transformation, transmission and distribution of electricity in Québec represented only 9% of the electricity produced or received (exports deducted), whereas these losses reached approximately 50% in countries where the bulk of electricity is thermally generated.

Despite this comparative advantage, the overall efficiency of Québec's energy transformation system was only 66% in 1987, because of the way in which energy consumption was distributed. Natural gas, a very efficient form of energy, accounted for only 14.8% of Québec's energy consumption in 1986 whereas oil, the least efficient energy source, accounted for 42.1%. Thus, the advantage gained by Québec through its significant hydroelectric production was diminished somewhat through neglect of the more efficient natural gas. Nevertheless, the penetration of natural gas and electricity on the Québec energy market in the last few years has contributed to a significant improvement in the overall efficiency of the system (66% in 1987, compared to 58% in 1980).

COMPARISON OF THE ENERGY SYSTEMS IN QUÉBEC AND ONTARIO

In order to evaluate the efficiency of Québec's energy transformation system, the same calculations were made for Ontario, based on identical assumptions. The data (in million toe) were taken from Statistics Canada catalogue 57-003. The results of these calculations for Ontario are given in Graph 3.2. Table 3.1 compares the efficiency of energy systems in Québec and Ontario.

In 1987, Québec's energy transformation system was more efficient than Ontario's. Overall system efficiency reached 66% in Québec, compared to 58% in Ontario; these levels having been 66% and 60%, respectively, in 1986. More detailed analysis of these results shows that the higher efficiency of Québec's system is essentially due to the important role of hydroelectricity in energy consumption. In 1987, Québec's energy system used electricity at an efficiency rate of 91%, whereas in Ontario this rate was only 66%. This disparity is due to the substantial losses incurred by Ontario's energy system in the production, transformation and transmission of electricity. The greater part of Ontario's electricity comes from thermal energy, which explains the high production losses from the transformation of primary energy into secondary energy. These losses represented 34% of the electricity produced or received in Ontario (not including exports), but only 9% in Québec. Furthermore, the efficiency rates for oil and natural gas were significantly lower in Ontario than in Québec. In the case of oil, this is explained by the relative importance of Ontario's transportation sector in the final consumption of oil. In fact, it is in this sector that the efficiency of petroleum products is the lowest.

For each form of energy, then, with the exception of coal, the results recorded for Québec's energy system were significantly higher than those for Ontario's. The overall efficiency of Québec's energy system surpassed that of the Ontario system by 8 points. It should be pointed out, however, that Ontario's most efficient forms of energy (coal and natural gas) have a share of energy consumption that is three times greater in Ontario than in Québec. The minor role played by these forms of energy, especially by natural gas, in Québec's energy consumption has partially reduced the advantage gained through the availability of abundant hydroelectric resources.

Table 3.1

EFFICIENCY OF THE ENERGY TRANSFORMATION SYSTEMS IN QUÉBEC AND ONTARIO, BY FORM OF ENERGY
1987

In %

	Québec		Ontario	
	Efficiency[1]	Share of energy consumption	Efficiency[1]	Share of energy consumption
Coal[2]	87	1.4	83	8.5
Oil[3]	34	42.1	29	36.6
Natural gas[4]	81	14.8	78	33.5
Electricity	91	41.7	66	21.4
All forms of energy	66	100.0	58	100.0

1. Percentage of available energy transformed into useful output.
2. Including coke and coke-oven gas.
3. Includes crude oil and the following products: gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke, propane, butane and still gas.
4. Natural gas.

Graph 3.1

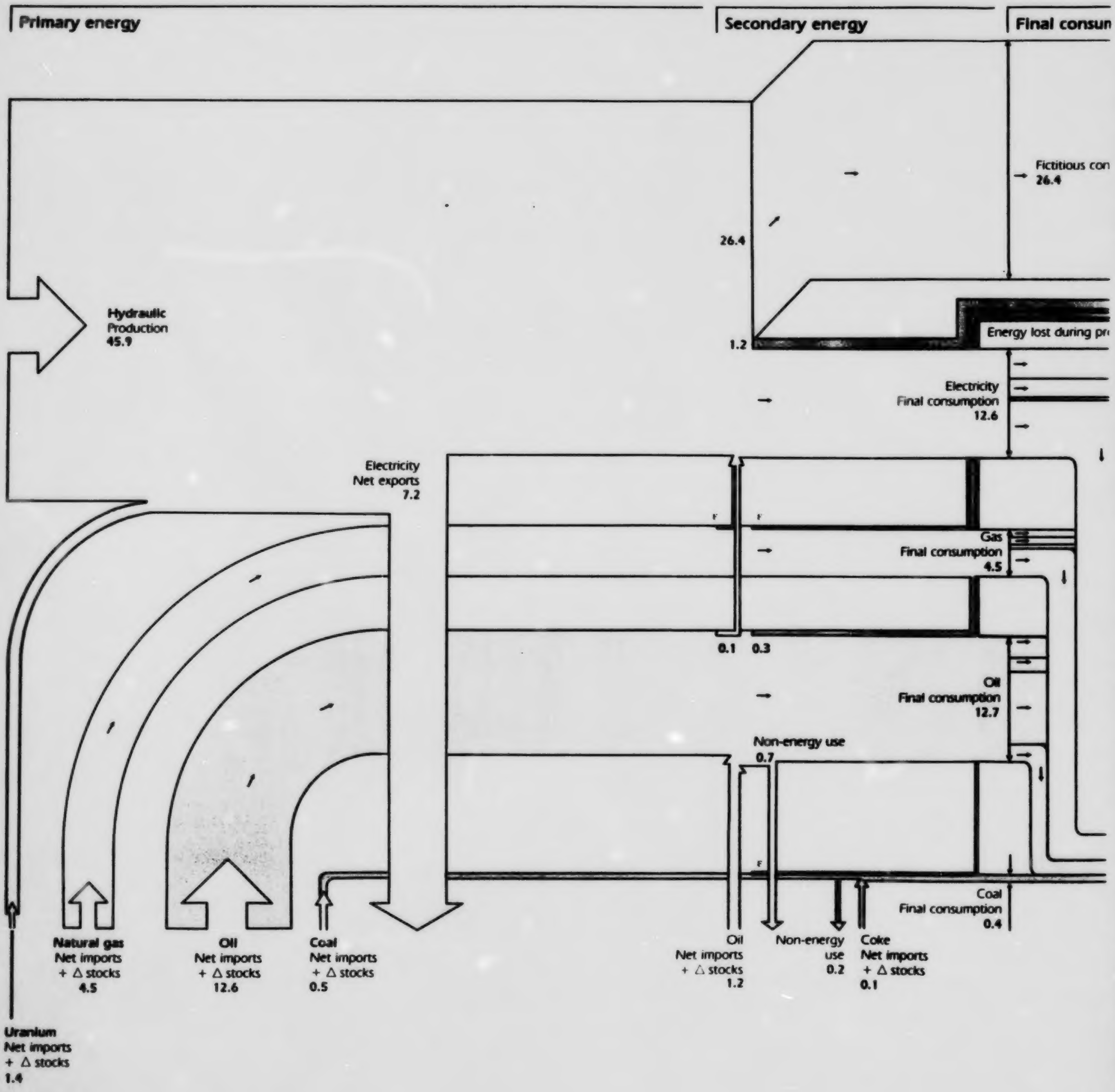
THE ENERGY TRANSFORMATION SYSTEM IN QUÉBEC
1987

In 10^6 toe

The flow of the various forms of conventional energy is shown starting on the left-hand side of the chart (domestic production, net imports and exports, and stock variations). After part of the primary energy has been transformed into secondary energy, the flow meets the final requirements of the various consumption sectors.

This chart is based on data for 1987. It shows the losses incurred in the production of primary and secondary energy, and in the transmission and distribution of the various forms of energy. It also takes into account the fraction of final energy consumption not transformed into useful output.

For 1987, total energy consumption was 30.1 × 10^6 toe. The overall efficiency of the system can be estimated at approximately 66%.


Primary energy
Secondary energy
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Fictitious con
26.4
26.4
Hydraulic
Production
45.9
1.2
Energy lost during pr
Electricity
Final consumption
12.6
Electricity
Net exports
7.2
F
F
Gas
Final consumption
4.5
0.1
0.3
Oil
Final consumption
12.7
Non-energy use
0.7
F
Coal
Final consumption
0.4
Natural gas
Net imports
+ Δ stocks
4.5
Oil
Net imports
+ Δ stocks
12.6
Coal
Net imports
+ Δ stocks
0.5
Oil
Net imports
+ Δ stocks
1.2
Non-energy
use
0.2
Coke
Net imports
+ Δ stocks
0.1
Uranium
Net imports
+ Δ stocks
1.4

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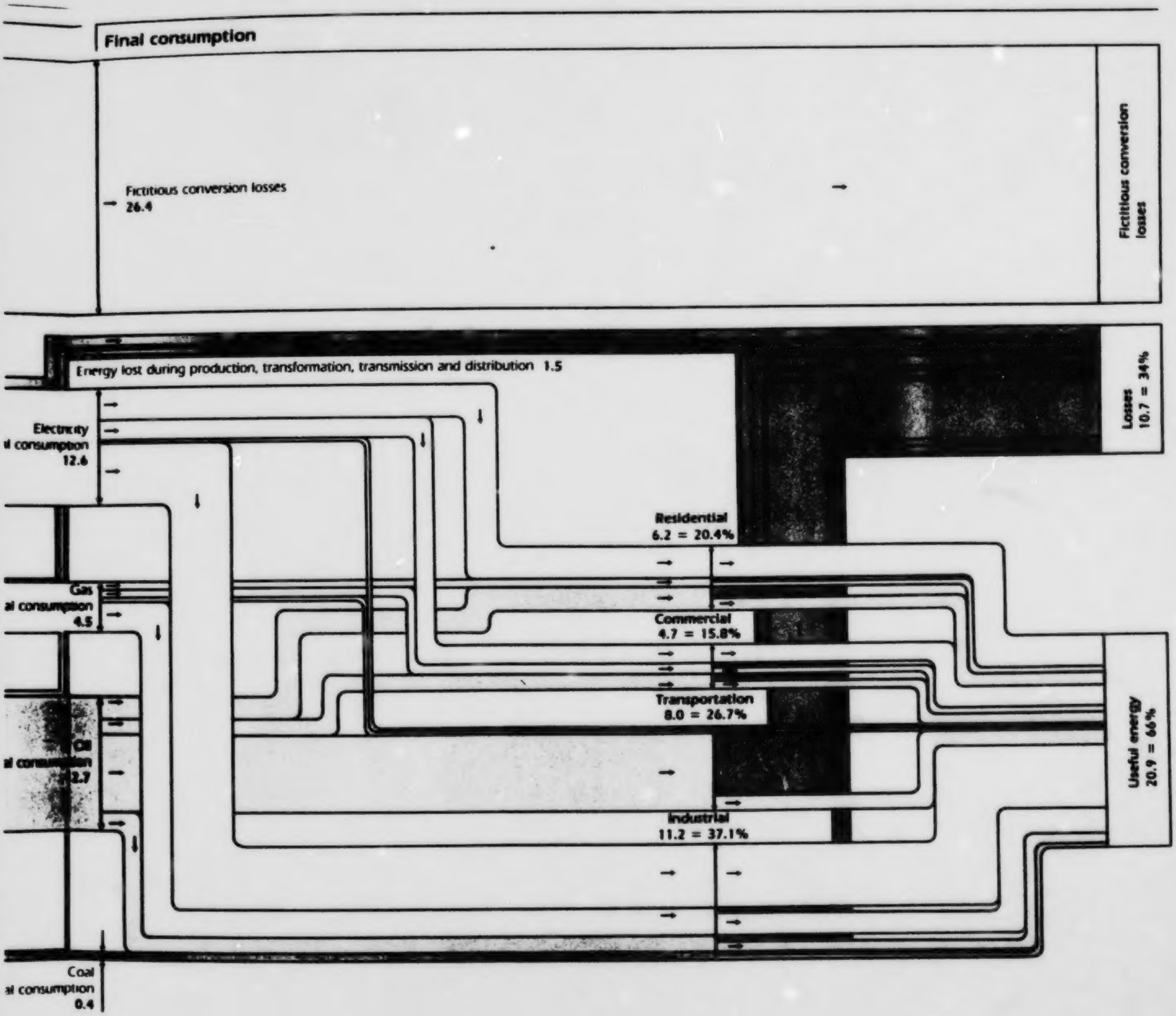
Final consumption
Fictitious conversion losses
26.4
Fictitious conversion losses
Energy lost during production, transformation, transmission and distribution 1.5
Losses
10.7 = 34%
Electricity
al consumption
12.6
Residential
6.2 = 20.4%
Gas
al consumption
4.5
Commercial
4.7 = 15.8%
Transportation
8.0 = 26.7%
Oil
al consumption
2.7
Useful energy
20.9 = 66%
Industrial
11.2 = 37.1%
Coal
al consumption
0.4

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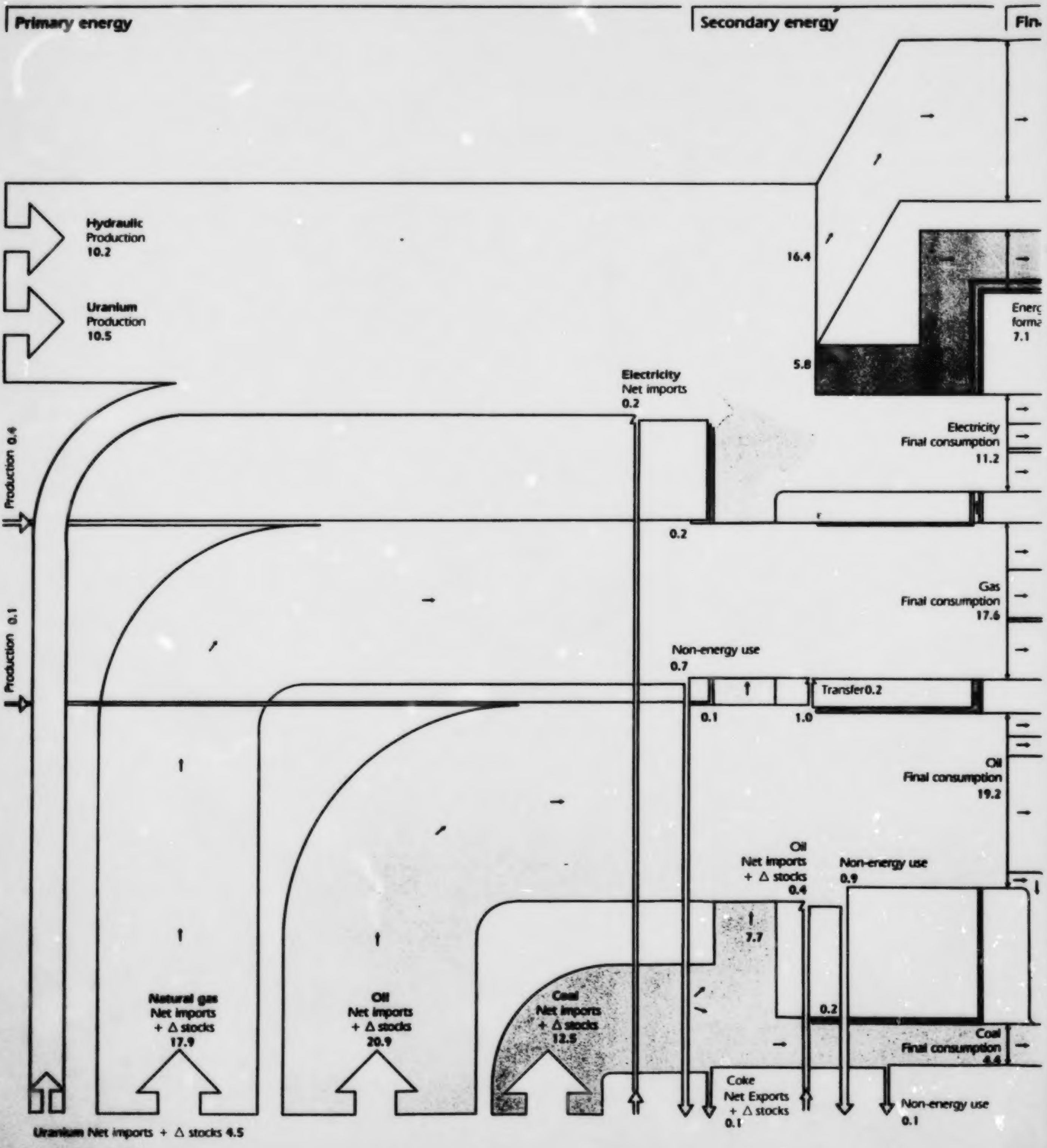
THE ENERGY TRANSFORMATION SYSTEM IN ONTARIO
1987

In 10^6 toe

The flow of the various forms of conventional energy is shown starting on the left-hand side of the chart (domestic production, net imports and exports, and stock variations). After part of the primary energy has been transformed into secondary energy, the flow meets the final requirements of the various consumption sectors.

This chart is based on data for 1987. It shows the losses incurred in the production of primary and secondary energy, and in the transmission and distribution. It also takes into account the fraction of final energy consumption not transformed into useful output.

Total energy consumption in 1987 was 52.5 × 10^6 toe. The overall efficiency of the system can be estimated at approximately 58%.


Primary energy
Secondary energy
Fin
Hydraulic
Production
10.2
Uranium
Production
10.5
16.4
5.8
Energ
forma
7.1
Electricity
Net imports
0.2
Electricity
Final consumption
11.2
Production 0.4
0.2
Production 0.1
Gas
Final consumption
17.6
Non-energy use
0.7
Transfer0.2
0.1
1.0
Oil
Final consumption
19.2
Oil
Net imports
+ Δ stocks
0.4
Non-energy use
0.9
7.7
0.2
Natural gas
Net imports
+ Δ stocks
17.9
Oil
Net imports
+ Δ stocks
20.9
Coal
Net imports
+ Δ stocks
12.5
Coal
Final consumption
4.4
Coke
Net Exports
+ Δ stocks
0.1
Non-energy use
0.1
Uranium Net imports + Δ stocks 4.5

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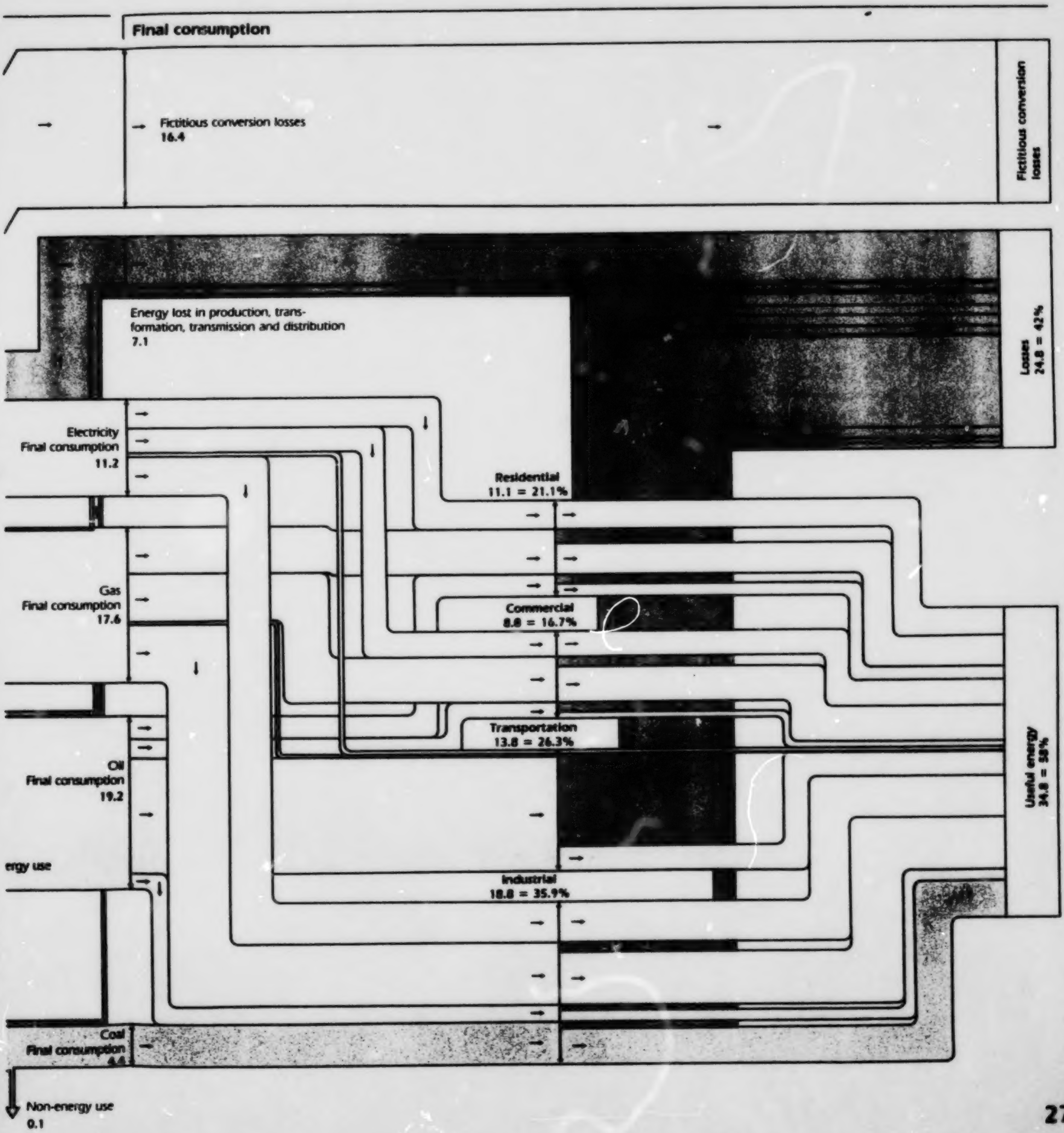

Final consumption
Fictitious conversion losses
16.4
Fictitious conversion losses
Energy lost in production, transformation, transmission and distribution
7.1
Losses
24.8 = 42%
Electricity
Final consumption
11.2
Residential
11.1 = 21.1%
Gas
Final consumption
17.6
Commercial
8.8 = 16.7%
Transportation
13.8 = 26.3%
Oil
Final consumption
19.2
Useful energy
34.8 = 58%
ergy use
Industrial
18.8 = 35.9%
Coal
Final consumption
4.4
Non-energy use
0.1

Graph 3.1 illustrates the energy transformation system in Québec (excluding alternative energy sources) and allows an estimate of its efficiency.

The flow of the different forms of primary energy starts on the left-hand side of the graph (domestic output plus net imports or minus net exports, taking stock variations into account).

A portion of this primary energy is transformed into secondary energy (coal transformed into coke and coke-oven gas; crude oil refined to become petroleum products; diesel fuel, light fuel oil, heavy fuel oil and natural gas used to produce thermal electricity). The supply of non-transformed primary energy obtained through transformation must be decreased by net exports or increased by net imports, once again taking stock variations into account.

Fictitious conversion losses in the electricity sector

To measure the losses attributable to conversion at the primary energy level in the electricity sector, the OECD method was applied. This method consists in applying to the production and trade of hydroelectric and nuclear power a conversion rate based on the quantity of oil which would theoretically be required to produce an equivalent amount of electricity. At this stage, the energy system is being evaluated from the producer's standpoint. The OECD conversion rate for Canada is 0.252 toe per 10^3 kWh. At the level of the final consumer, a conversion coefficient was applied to electricity generally — again according to the OECD method — without taking into account the origin of the electricity produced. This is logical since, in this case, the energy system is being studied from the consumer's standpoint. The conversion coefficient applied is found in the table "Coefficients for Conversion from the International System into OECD Metric System Thermal Units" (Appendix 1, p. 113). The quantity of energy lost in this change in conversion rate is indicated on the graph under "Fictitious conversion losses."

Losses incurred during production, transformation and transmission

Following the transformation and trade represented in the graph, Québec had a given amount of energy available for final consumption. This amount does not correspond to the total amount of energy received by the system, the difference being attributable to losses incurred during production, transformation and transmission.

Graph 3.1 shows that, in 1987, Québec produced or received a 58.0 million toe supply of energy, taking into account all external trade. If the fictitious conversion losses for the electricity sector were subtracted, the supply of energy received or produced would be 31.6 million toe. Since the actual final consumption totalled 30.1 million toe, losses incurred during production, transformation and transmission can be estimated at 1.5 million toe.

Energy losses during consumption

The amount of energy available for final consumption is divided between the four consumption sectors (residential, commercial, transportation and industrial).

Not all energy consumed is transformed into useful output: a fraction, which varies depending on equipment and the form of energy used, is lost during the final consumption stage (e.g. transformation into heat of some of the fuel used for lighting or transportation).

The amount of energy not transformed into useful output was calculated on the basis of efficiency estimated for each form of energy, taken sector by sector (see the assumptions given in the subsection "Equipment Efficiency," p. 29). For 1987, the amount of energy transformed into useful output has been calculated at 20.9 million toe (with losses during the final consumption stage amounting to 10.7 million toe).

Assumptions

I- Primary and secondary energy produced or received by Québec

These figures are taken from Table A in Appendix 2. The primary energy for oil includes liquefied petroleum gas imports (propane and butane), but does not include the amount of crude oil used to produce non-energy petroleum products. The figures for Québec's electricity production include electricity from Churchill Falls, since it is available to Québec through a long-term contract.

II- Calculation of losses incurred during production, transformation, and transmission/transportation

As already seen, the amount of losses incurred was determined by measuring the difference between the energy supplies received by Québec and the final consumption level (taking into account external trade and stock variations). This method was used for the sake of simplification. The losses derived in this way are in fact the sum of four items which may really be considered as losses in themselves.

These four items are grouped together in Paragraph 3, "Producer consumption, stock variations and adjustments," in the "Resources" section of the energy balance sheet found in Appendix 2.

- Item 3a, "Producer Consumption," represents the energy used by the energy industries themselves (the petroleum products used by refineries, electricity used by Hydro-Québec, etc.). In the preparation of the overall energy statistics, it was decided that, since producer consumption reduced the amount of energy available for final consumption, this amount should be subtracted from the available resources. Had the amount of energy consumed by the producers been included, the amount of energy available for final consumption would have increased accordingly, in which case it would have been necessary to insert a new consumption item, "Consumption by Energy Industries." Although this is what Statistics Canada chose to do in Catalogue 57-003, it was decided that this form of presentation would have created problems in the analysis of the consumption by sector. It was also felt that the concept of total net energy is clearer.
- The items "Other Products Used" (3c for secondary energy) and "Inter-Product Transfers" (3c for primary energy and 3d for secondary) are either accounting adjustments of transformations within the refining industry. They seemed to logically qualify as losses.
- Item 3e, "Losses and Adjustments" (which appears only under "Secondary Energy"), presents no particular problem.

III- Final consumption

These figures are taken from Table C in Appendix 2. The consumption attributed to item 5, "Other Uses," was distributed between the four utilization sectors. This was done on the basis of the relative importance of each form of energy to each sector, to the exclusion of "other uses."

IV- Equipment efficiency

Efficiency percentages were based on data provided by Energy, Mines and Resources Canada. In some cases, these percentages were adjusted to fit Québec's particular situation in this area.

Form of energy	Consumption sector	Efficiency
COAL	Residential	50%
	Commercial	65%
	Rail transportation	8%
	Shipping	8%
	Industrial	87%
OIL		
Gasoline	Road transportation	20%
Aviation gasoline	Air transportation	20%
Jet fuel	Air transportation	30%
Kerosene	Residential	55%
	Commercial	82%
	Rail transportation	55%
	Shipping	55%
	Industrial	82%
Diesel fuel	Residential	23%
	Commercial	23%
	Rail transportation	23%
	Shipping	15%
	Rail transportation	23%
	Industrial	26%
Light fuel oil	Residential	65%
	Commercial	80%
	Rail transportation	80%
	Shipping	10%
	Industrial	80%
Heavy fuel oil	Residential	80%
	Commercial	80%
	Rail transportation	80%
	Shipping	10%
	Industrial	87%
Liquefield petroleum gas	Residential	75%
	Commercial	78%
	Road transportation	20%
	Industrial	85%
Still gas	Industrial	85%
NATURAL GAS	Residential	68%
	Commercial	78%
	Road transportation	22%
	Industrial	85%
ELECTRICITY	Residential	100%
	Commercial	100%
	Road transportation	100%
	Industrial	100%

4. ENERGY PRICES

CRUDE OIL

At the international level, 1987 was marked by an increase in the price of crude oil. The price of Canadian crude, reflecting the international scene, underwent a similar upturn. In Québec, the average price for all oil treated in Québec refineries increased by 7.8% in one year, from $22.77 per barrel in 1986 to $24.54 per barrel in 1987. Despite this rise, the price of oil in Québec remains relatively low compared to the highest price recorded in 1985, which was $38.46 per barrel.

The increase in the price of oil delivered to Montréal, recorded since early 1987, continued into the third quarter of the year, when the price paid by refineries stood at $25.84 per barrel. Since then, the price of oil has fallen and, in the first quarter of 1988, refineries were paying 16.8% less than in the third quarter of 1987.

Table 4.1

AVERAGE PRICE OF CRUDE OIL DELIVERED TO QUÉBEC — INTERNATIONAL PRICE AND PRICE PAID BY REFINERS 1971-1987

In current dollars per barrel

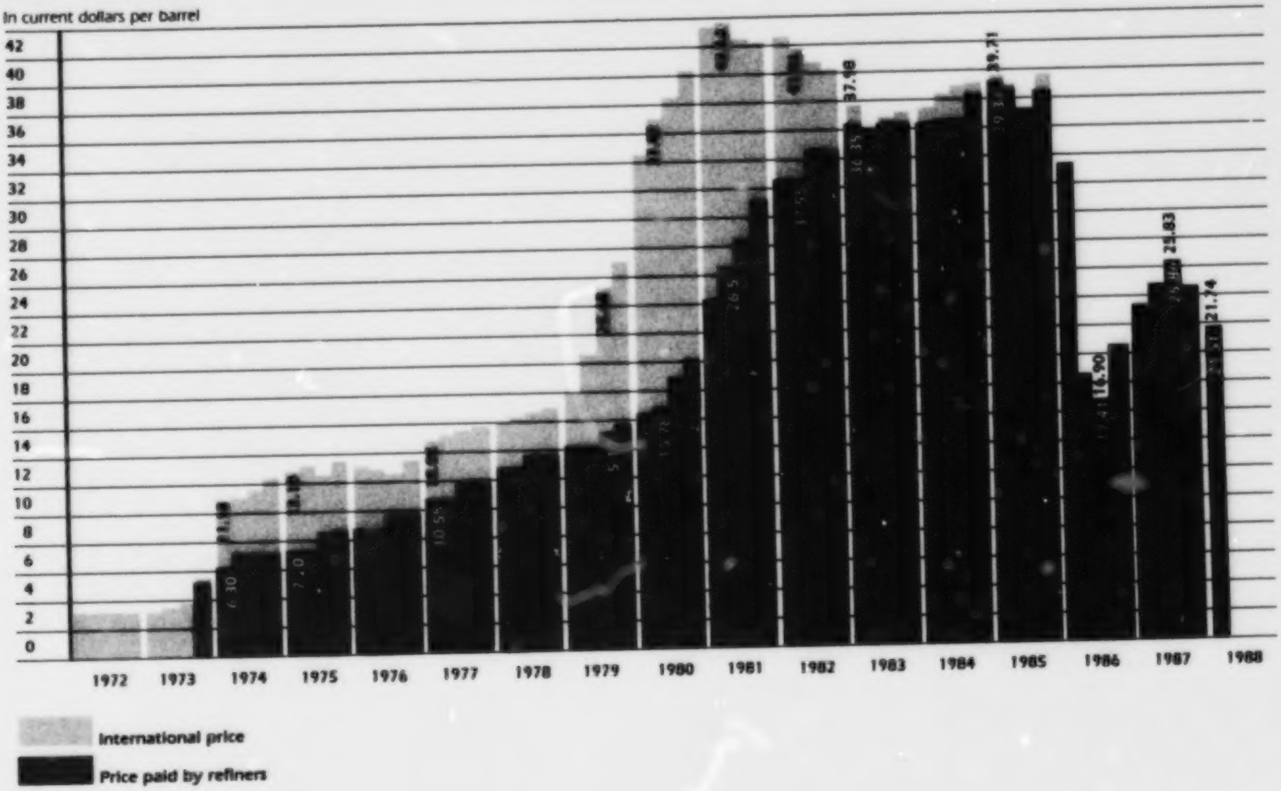
Year	International price[1]	Price paid by refiners[2]
1971	3.00	3.00
1972	3.10	3.10
1973	3.87	3.87
1974	11.68	6.97
1975	13.09	7.98
1976	13.16	9.33
1977	15.42	11.05
1978	16.54	13.20
1979	22.89	14.72
1980	37.57	18.17
1981	42.83	27.76
1982	41.30	33.69
1983	36.63	36.38
1984	38.38	36.88
1985	38.77 rd	38.46 rd
1986	22.22	22.77 rd
1987	24.75	24.54

rd: revised data

1. Average price of imported crude oil delivered to Montreal from the international market.
2. Actual average price paid by refiners for all crude oil delivered to Montreal from both Canadian and international markets.

Graph 4.1

AVERAGE PRICE OF CRUDE OIL DELIVERED TO QUÉBEC — INTERNATIONAL PRICE AND PRICE PAID BY REFINERS



N.B.: These data are quarterly averages.

PETROLEUM PRODUCTS

The increase in the price of crude oil was reflected in the price of most petroleum products, so that for 1987 as a whole, the average increase in petroleum product prices in Montréal reached 13,9% for heavy fuel oil, 4.1% for gasoline and 1.4% for diesel oil. Conversely, the price of light fuel oil fell by 3.4%, compared to last year. The decrease in the price of light fuel oil was due to the drop in the margin of distribution.

Comparison between the prices of petroleum products in Québec and those in the major industrialized countries reveals some significant disparities. In 1987, the price of gasoline in Québec was 68% higher than in the U.S., but 32% to 56% lower than in major European countries. Québec prices for light fuel oil were comparable to those of the U.S., the United Kingdom, Belgium and Germany, but were significantly lower than those of Sweden, France, Italy, Denmark and Japan.

The basic explanation for these price differences from one country to another lies in consumer taxes. In relation to the major industrialized countries with which the comparisons were made for 1987, Québec had the lowest taxation level for gasoline, after the United States. Despite the reestablishment in 1986 of the sales tax on light fuel oil, Québec compares favorably to most of the industrialized countries with respect to the level of taxation of this product. In the comparison of petroleum product prices, the tax discrepancies hide a somewhat different reality. Analysis of the pre-tax levels in the major industrialized countries reveals that Québec's prices are among the highest, both for gasoline and light fuel oil.

In April 1988, gasoline prices in Québec were the highest in Canada. However, the price spread between Québec and some other provinces was relatively narrow: Québec's gasoline prices were 4% higher than Newfoundland's, 7% higher than Prince Edward Island's, 11% higher than Nova Scotia's and 15% higher than Ontario's.

Analysis of the average price of gasoline for the first quarter of 1988 shows that, compared to the situation in 1987, the price gap narrowed in the various administrative regions of Québec. In the first half of 1988, there was an 8.5% spread between the highest prices (those in the Trois-Rivières region) and the lowest (those in the Outaouais region). In 1987, the widest spread within the province was 11.5%. In September 1987, the ministère de l'Énergie et des Ressources created the Bureau d'inspection et d'information du prix de l'essence (BIPE). This agency was created to inquire into changes in gasoline prices and the breakdown of prices, as well as to inform consumers in outlying regions of the results obtained.

Table 4.2

PETROLEUM PRODUCT PRICES[1] IN MONTRÉAL
1971-1987

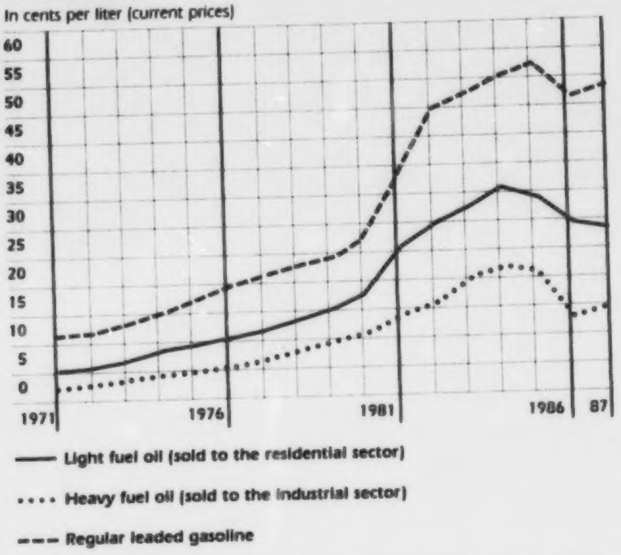
In cents per liter (current prices)

Year	Light fuel oil (sold to the residential sector)[2]	Heavy fuel oil (sold to the industrial sector)[3]	Regular leaded gasoline[2] [4]	Diesel fuel (sold to the road transportation sector)[2] [4]
1971	4.51	1.56	10.82	12.85
1972	4.99	2.05	11.17	13.14
1973	5.96	2.71	12.16	14.08
1974	7.96	3.56	14.17	15.38
1975	8.64	3.85	16.32	16.57
1976	9.71	4.62	18.89	17.95
1977	11.20	5.83	20.46	19.49
1978	12.49	7.37	22.19	21.69
1979	14.16	8.80	23.28	22.07
1980	17.07	10.12	26.48	26.41
1981	25.15	13.20	37.77	37.26
1982	29.17	15.16	49.38	48.23
1983	31.77	19.42	51.71	47.73
1984	34.76	21.38	54.60	46.48
1985	33.63	20.63	56.64	49.52
1986	28.88	12.55	50.89	49.90
1987	27.89	14.30	52.99	50.62

1. Consumer price, including discount, retailer's profit margin and taxes.
2. Source: Direction des produits pétroliers of the ministère de l'Énergie et des Ressources du Québec.
3. Price of #6 fuel oil, 3% sulfur. Price corresponding to that paid by major consumers and quoted from the **Oil Buyers' Guide**.
4. Consumer price.

Graph 4.2

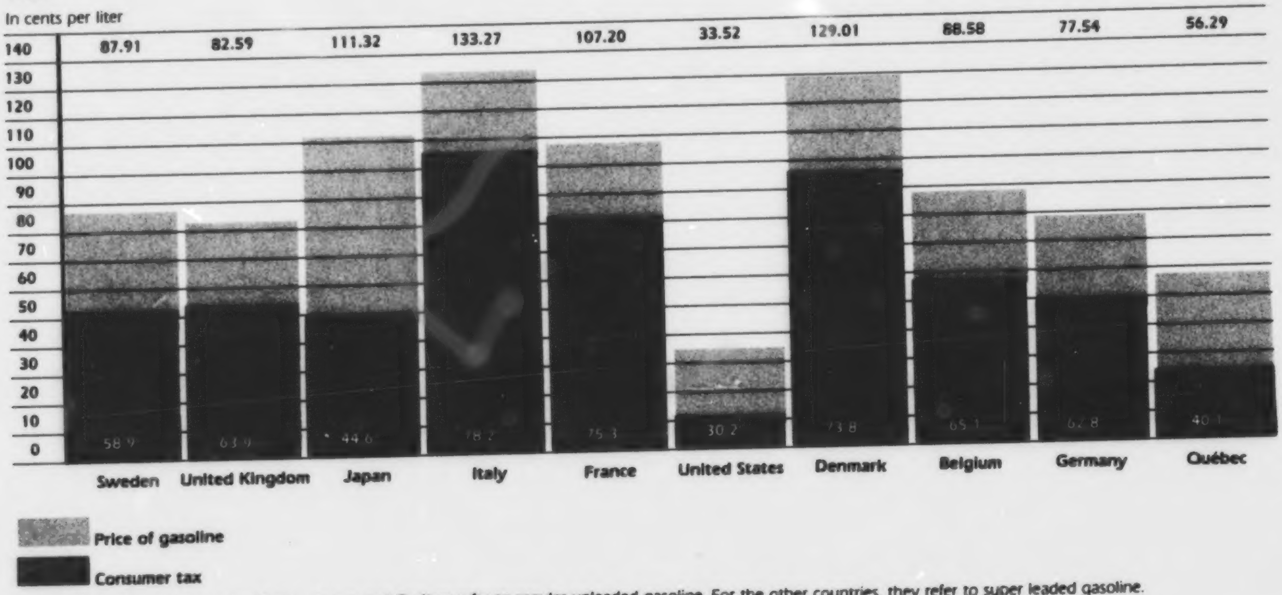
PETROLEUM PRODUCT PRICES IN MONTRÉAL



Graph 4.3

WORLD GASOLINE PRICES — QUÉBEC AND MAJOR INDUSTRIALIZED COUNTRIES[1]

1987

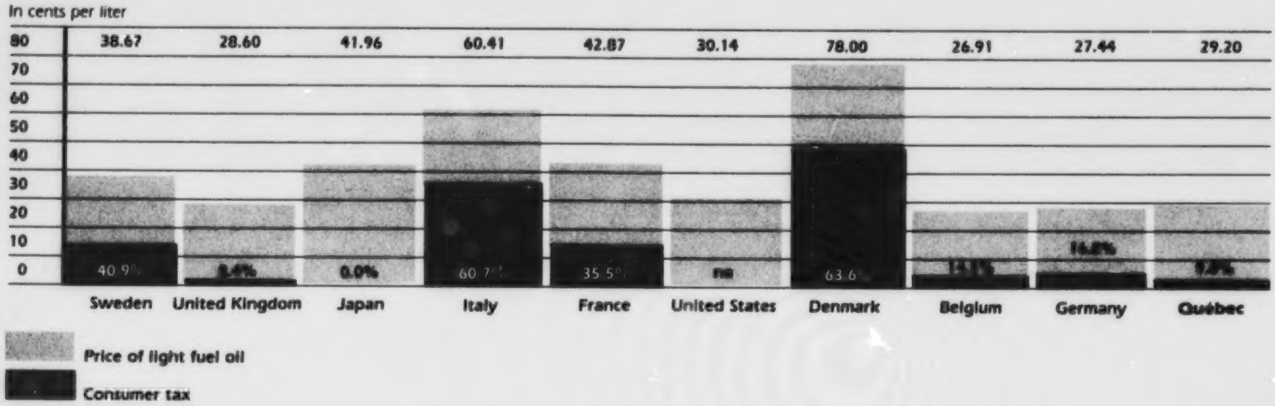


[1] Gasoline prices for the United States, Japan and Québec refer to regular unleaded gasoline. For the other countries, they refer to super leaded gasoline.

Sources: International Energy Agency, and the ministère de l'Énergie et des Ressources du Québec.

Graph 4.4

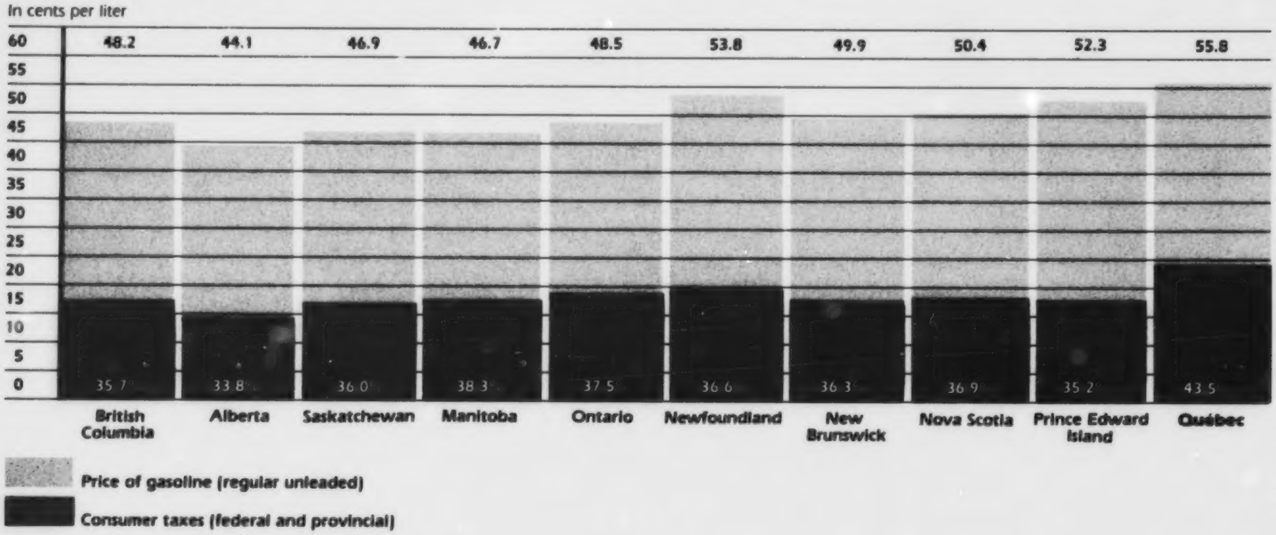
WORLD LIGHT FUEL OIL PRICES — QUÉBEC AND MAJOR INDUSTRIALIZED COUNTRIES 1987



na: not available
Sources: International Energy Agency, and the ministère de l'Énergie et des Ressources du Québec.

Graph 4.5

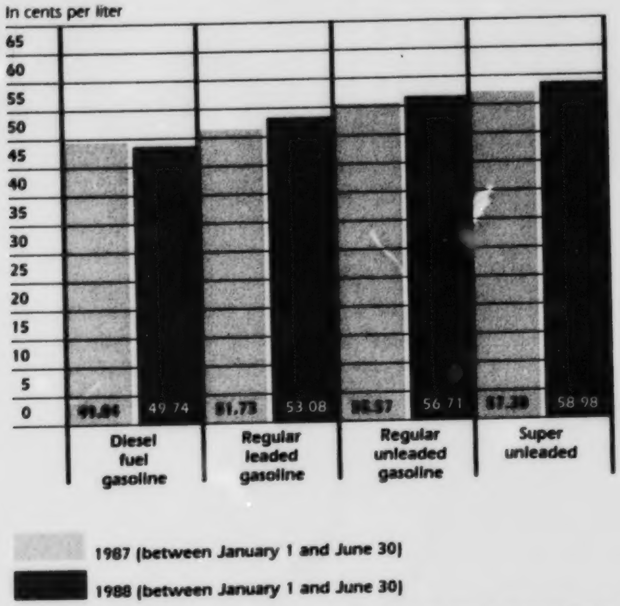
GASOLINE PRICES IN CANADA, BY PROVINCE WEEK OF APRIL 1, 1988



Source: Petroleum Resources Communication Foundation, Alberta.

Graph 4.6

AVERAGE PRICES OF DIESEL FUEL AND OF THE VARIOUS TYPES OF GASOLINE IN QUÉBEC
1987-1988



Sources: Direction des produits pétroliers and Direction du pétrole of the ministère de l'Énergie et des Ressources du Québec.

Table 4.3

AVERAGE RETAIL PRICE OF GASOLINE[1] BY ADMINISTRATIVE REGION
1987-1988

Regions	Ratio to Québec as a whole		Average price (cents per liter)	
	1987[2]	1988[2]	1987[2]	1988[2]
Bas-Saint-Laurent – Gaspésie	103.0	100.7	57.26	57.12
Saguenay – Lac-Saint-Jean	97.7	95.4	54.28	54.12
Québec	99.6	99.6	55.37	56.51
Trois-Rivières	100.5	101.5	55.85	57.54
Estrie	98.6	97.6	54.81	55.33
Montréal	100.6	101.0	55.91	57.27
Outaouais	92.4	93.5	51.37	53.02
Abitibi – Témiscamingue	102.3	98.7	56.83	55.98
Côte-Nord	99.8	98.7	55.46	55.96
Nouveau-Québec	na	na	na	na
Québec as a whole	100.0	100.0	55.57	56.71

na: not available

[1] Regular unleaded gasoline.

[2] Between January 1 and June 30.

Sources: Direction des produits pétroliers and Direction du pétrole of the ministère de l'Énergie et des Ressources du Québec.

COMPONENTS OF THE PRICE OF GASOLINE

The price of gasoline includes levies imposed by the various governments concerned: the federal government and those of the producing and consuming provinces. As of April 5, 1988, overall levies in Montréal constituted 48.6% of the final price, as opposed to 51.6% in February 1987. This decrease in government levies results from a tax cut by Québec and the producing provinces: within the space of one year, these taxes dropped from 27.6% to 25.3%, and from 7.8% to 5.1%, respectively. This tax cut by the provinces was partly compensated by the increase in federal taxes, which rose from 16.2% to 18.3%. The sum of the levies imposed by the federal government and the producing provinces represents nearly half the government-imposed taxes on the price of gasoline. It should be noted that these data refer to prices observed in Montréal. Québec's provincial tax is reduced for gasoline consumers in the peripheral and border regions.

As of April 5, 1988, production and transportation costs as well as the profit margin of dealers and of the oil industry represented 51.4% of the price of gasoline, compared to 48.4% in 1987. This increase mainly benefited oil producers, whose post-tax returns jumped from 10.7% to 13.9%.

Analysis of the components of the annual cost of operating a car in Québec shows that in 1988 the share of gasoline in these costs remained virtually the same as in 1987. This share was between 16% and 19% depending on the model of the car: gasoline costs increased with the number of cylinders in the engine.

Tableau 4.4

COMPONENTS OF THE PRICE OF GASOLINE — AVERAGE CONSUMER PRICE OF REGULAR UNLEADED GASOLINE IN MONTRÉAL FEBRUARY 5, 1988

	Components of the price of gasoline	
	cents per liter	%
Québec levies	**14.5**	**25.26**
Road tax	*14.4*	*25.09*
Refinery tax	*0.1*	*0.17*
Federal levies	**10.5**	**18.29**
Federal tax on crude oil production	*0.6*	*1.05*
Federal excise tax	*6.5*	*11.32*
Federal sales tax	*3.4*	*5.92*
Producing province levies	**2.9**	**5.05**
Taxes and charges	*0.3*	*0.52*
Property tax	*2.6*	*4.53*
Production costs for crude oil	**1.5**	**2.61**
Producer's post-tax returns[1]	**8.0**	**13.94**
Crude oil transportation costs	**1.1**	**1.92**
Industry's gross profit margin for refining and distribution	**14.5**	**25.26**
Retailer's gross profit margin	**4.4**	**7.67**
Average price	**57.4**	**100.00**

1. Crude oil producer's returns, after deduction of production costs, and federal and provincial taxes and levies on production.

Sources: Petroleum Resources Communication Foundation, Alberta, and the ministère de l'Énergie et des Ressources du Québec.

Table 4.5

SHARE OF GASOLINE IN THE ANNUAL COST OF OPERATING AN AUTOMOBILE, BY CATEGORY[1] 1980-1988

	Sub-compact			Compact			Intermediate			Standard		
	Cost of gasoline		Total costs	Cost of gasoline		Total costs	Cost of gasoline		Total costs	Cost of gasoline		Total costs
Year[2]	$	%	$	$	%	$	$	%	$	$	%	$
1980	707	20.7	3,416	1,044	23.9	4,375	1,071	22.0	4,863	1,229	22.3	5,517
1981	844	21.4	3,936	1,154	22.5	5,128	1,271	21.8	5,836	1,348	21.1	6,395
1982	959	20.6	4,666	1,186	20.7	5,730	1,409	21.0	6,704	1,575	22.0	7,174
1983	977	21.7	4,495	1,222	21.8	5,604	1,420	22.4	6,338	1,737	24.3	7,144
1984	1,010	21.2	4,769	1,298	22.7	5,728	1,512	24.7	6,112	1,816	26.0	6,983
1985	992	20.3	4,882	1,262	21.2	5,956	1,451	23.0	6,311	1,735	24.9	6,961
1987	893	16.8	5,312	1,103	16.8	6,582	1,262	18.4	6,857	1,541	19.7	7,807
1988	900	16.4	5,476	1,172	17.3	6,783	1,316	18.0	7,324	1,566	19.0	8,252

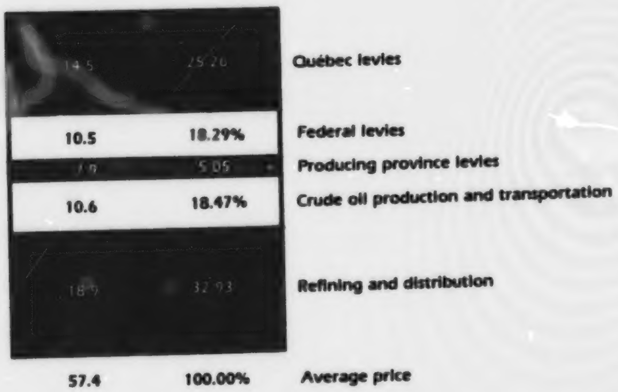
1. For an automobile driven 22,500 kilometers.
2. For 1980-1985, the Club automobile du Québec calculated car operating cost as of December each year. The operating costs for 1987 and 1988 correspond to data provided for the month of January. The Club has given no evaluation of costs for 1986.

Source: Club automobile du Québec.

Graph 4.7

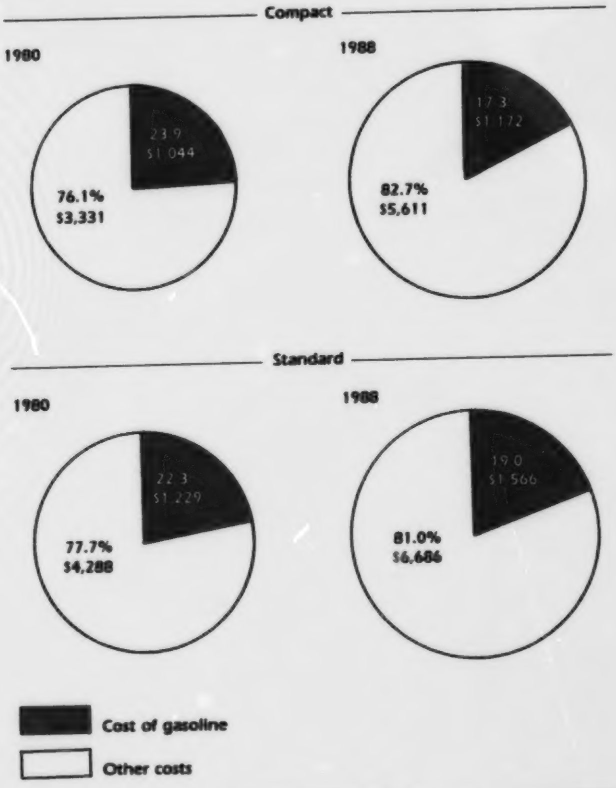
COMPONENTS OF THE PRICE OF GASOLINE — AVERAGE CONSUMER PRICE OF REGULAR UNLEADED GASOLINE IN MONTRÉAL AS OF APRIL 5, 1988

In cents per liter



Graph 4.8

SHARE OF GASOLINE IN THE ANNUAL COST OF OPERATING AN AUTOMOBILE



NATURAL GAS

In 1987, the average selling price of natural gas delivered to a franchise in Québec decreased by 4.7% over its 1986 level. This decrease is essentially due to the deregulation of natural gas prices in November 1986 and to the ensuing adaptation to market conditions. It must be noted that the price chosen does not reflect the discounts given by producers in western Canada seeking to protect the most vulnerable gas markets from competition by other forms of energy.

Despite the reduction in the city-gate price for natural gas, the average selling price to consumers remained virtually the same as in 1986. This is essentially due to the increase in distribution costs. The stability of the average selling price includes different price variations depending on the sector of consumption. In 1987, natural gas prices rose by 2.3% in the residential sector and 1.7% in the commercial sector. In the industrial sector, the price of natural gas declined by 1.5%. It should be noted that these data do not reflect the May 2, 1986, reapplication of the 9% provincial sales tax on gas used for heating purposes.

Over the past few months, the structure of the price of gas at the consumer level has stabilized. A breakdown of the average sale price of gas sold by Gaz Métropolitain shows that, in July 1988, the price at the Alberta border represented 47.6% of the total cost (48.7% in July 1987), while transmission costs represented 19.7% (18.2% in 1987). The city-gate price of gas thus constituted 67.3% of the consumer price, as compared to 66.9% in 1987. Similarly, the share of the distribution profit margin remained steady at 29.2%. Levies imposed by Québec — which is to say, the nominal sales tax reintroduced in May 1986 — represented an average 3.8% of the consumer price.

Comparison between the average selling prices of natural gas by province shows that, in 1987, the spread between Québec and the rest of Canada widened in 1987. The gas sold in Québec that year was 36.6% higher than the Canadian average (31.3% in 1986), 13.0% higher than in Ontario (8.3% in 1986) and 116.6% higher than in Alberta (109.7% in 1986).

Over a longer period, the relative price of natural gas delivered to Québec has improved in relation to the rest of Canada. This relative improvement is due to the more substantial increase in the price paid to the producer, in comparison to the increase in transportation and distribution costs. However, there are still significant differences, which are widely attributable to transportation costs.

Table 4.6

NATURAL GAS PRICES — CITY-GATE PRICE AND AVERAGE PRICE BY CONSUMPTION SECTOR 1971-1987

In cents per m³ (current prices)

		Average selling price of natural gas[1]		
Year	**City-gate price**	**Residential sector**	**Commercial sector**	**Industrial sector**
1971	1.68	5.97	4.17	2.08
1972	1.68	5.61	4.34	2.26
1973	1.79	5.75	4.24	2.61
1974	2.19	5.97	4.66	3.00
1975	3.35	7.09	5.72	4.34
1976	4.80	8.79	7.52	6.00
1977	5.68	9.88	8.58	6.88
1978	6.71	11.66	10.12	7.99
1979	7.13	12.96	11.22	8.50
1980	8.61	14.52	12.43	9.80
1981	10.87	16.74	15.07	12.34
1982	13.59	21.00	18.97	16.40
1983	14.65	23.68	21.16	17.23
1984	14.61	25.07	22.15	18.44
1985	14.44	25.25	22.09	17.24
1986	14.21[2]	24.55	21.53	17.31
1987	13.54[2]	25.11	21.89	17.05

rd: revised data

1. Does not include provincial sales tax where applicable. This price corresponds to the average income (income divided by sales).
2. Does not include discounts given by producers in western Canada following the deregulation of gas prices in Canada.

Sources: Statistics Canada, catalogues 55-002 and 57-205; and the ministère de l'Énergie et des Ressources du Québec.

Graph 4.9

AVERAGE SELLING PRICE OF NATURAL GAS, BY CONSUMPTION SECTOR

In cents per m³ (current prices)

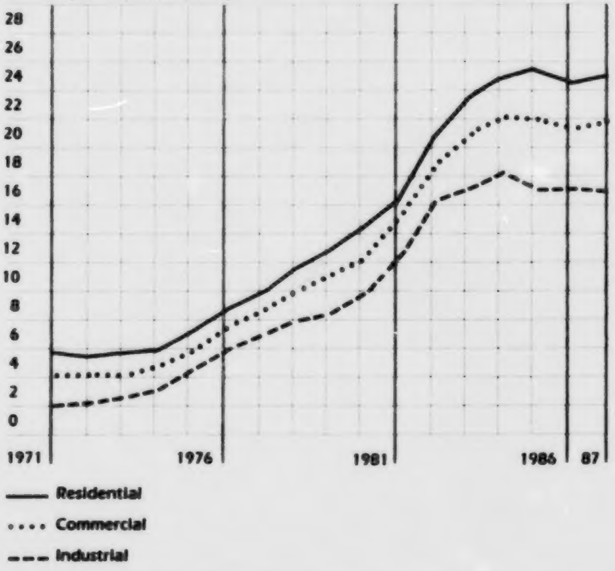


Table 4.7

COMPONENTS OF THE CONSUMER PRICE OF NATURAL GAS — AVERAGE SELLING PRICE OF NATURAL GAS SOLD BY GAZ MÉTROPOLITAIN
JULY 1988

	Components of the price of natural gas	
	cents per m³	%
Alberta border price	9.789[1]	48.77
Transportation cost (Alberta to Montréal)	4.046	19.70
Distribution gross profit margin	5.930	28.87
Provincial sales tax	0.773	3.77
Average consumer price	20.538	100.00

[1] Takes into account the basic discount allowed by producers, $0.758 per m³.

Source: Direction des études et statistiques of the ministère de l'Énergie et des Ressources du Québec.

Graph 4.10

AVERAGE SELLING PRICE OF NATURAL GAS IN QUÉBEC, ONTARIO AND ALBERTA

In cents per m³ (current prices)

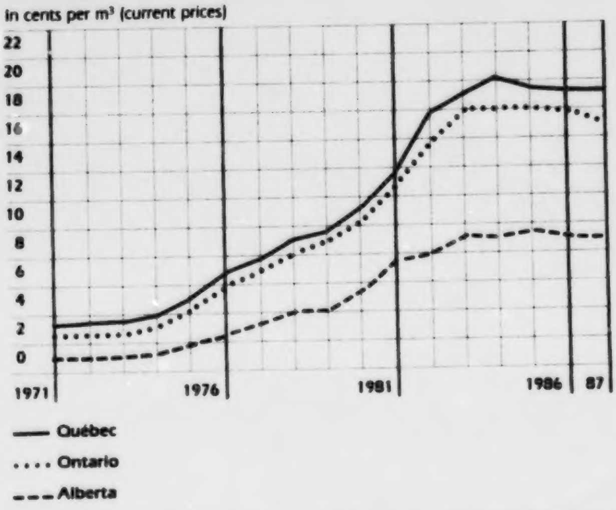


Table 4.8

AVERAGE SELLING PRICE OF NATURAL GAS BY PROVINCE
1971-1987

In cents per m³ (current prices)

Year	Québec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada
1971	3.35	2.72	2.29	1.69	1.16	2.75	2.26
1972	3.46	2.68	2.29	1.73	1.16	2.72	2.29
1973	3.64	2.72	2.29	1.69	1.16	2.54	2.29
1974	3.85	3.07	2.75	1.87	1.27	3.32	2.65
1975	5.08	4.17	3.95	2.61	1.80	3.49	3.49
1976	6.92	5.97	5.29	3.85	2.58	4.34	4.87
1977	7.80	6.95	6.32	4.87	3.28	5.40	5.68
1978	9.10	8.16	7.63	5.61	4.11	6.22	6.67
1979	9.68	8.93	8.10	6.21	4.32	7.08	7.22
1980	11.10	10.19	9.66	7.10	5.42	7.41	8.34
1981	13.62	12.80	11.78	9.12	7.60	10.19	10.80
1982	17.79	15.85	14.39	11.28	8.11	13.77	12.94
1983	19.08	18.01	15.82	12.19	9.29	14.22	14.55
1984	20.17	18.13	16.09	12.71	9.17	14.76	14.74
1985	19.39	18.07	16.14	12.84	9.56	15.21	14.83
1986	19.33	17.85 rd	15.91	12.85	9.22	15.17	14.72 rd
1987	19.24	17.03	15.40	11.84	9.09	13.17	14.08

rd: revised data

Source: Statistics Canada, catalogues 55-002 et 57-205.

ELECTRICITY

In 1987, electricity prices in Québec demonstrated fairly significant variations. The average selling price of electricity increased by 5.3% in the residential sector and 2.0% in the commercial sector, while it decreased by 1.7% in the industrial sector.

In general, electricity prices in Québec are among the most advantageous in North America. As of May 1, 1988, residential rates in Montréal were the lowest, along with those in Winnipeg. In some instances, the price spread was considerable, with rates higher in Vancouver (16.5%), Toronto (30.8%), and Halifax (57.5%). In New York, rates were more than three times higher.

The comparative advantage of Québec's rates is also felt in the industrial sector where, in the "medium power" category, Québec rates were 10.2% lower than those in Toronto, a rate difference which became 21.4% in the "larger power" category. As can be seen in graphs 4.13 and 4.14, this spread is even wider for most of the other cities for which the comparison was made. For these categories, rates in Winnipeg were lower than in Montréal. It should be noted that in Edmonton the spread in the rates is tied to the amount of consumption retained. This gap narrows significantly for consumption between 5,000 kW and 10,000 kW. The Edmonton Power electric company does not offer rates for 50,000 kW and over.

In 1988, the average selling price of electricity in Québec was 19.5% lower than the Canadian average. Electricity costs less in Québec than in all the other provinces and, during the 1971-1985 period, the cost of electricity in Québec was consistently lower than in Ontario.

Table 4.9

AVERAGE SELLING PRICE OF ELECTRICITY[1]
1971-1987

In cents per kWh (current prices)

Year	Residential sector	Commercial sector	Industrial sector
1971	1.51	1.48	0.64
1972	1.48	1.43	0.62
1973	1.55	1.49	0.66
1974	1.56	1.52	0.70
1975	1.68	1.66	0.86
1976	1.74	1.78	0.93
1977	1.88	1.98	1.08
1978	2.14	2.34	1.25
1979	2.48	2.73	1.51
1980	2.79	3.17	1.70
1981	3.09	3.45	1.93
1982	3.62	4.03	2.35
1983	3.89	4.32	2.52
1984	3.95	4.32	2.50
1985	4.01	4.34	2.44
1986	4.15	4.43	2.34
1987	4.37	4.52	2.30

1. This price corresponds to the average income (income divided by sales) and does not include provincial sales tax.

Sources: Hydro-Québec and the ministère de l'Énergie et des Ressources du Québec.

Graph 4.11

AVERAGE SELLING PRICE OF ELECTRICITY BY CONSUMPTION SECTOR

In cents per kWh (current prices)

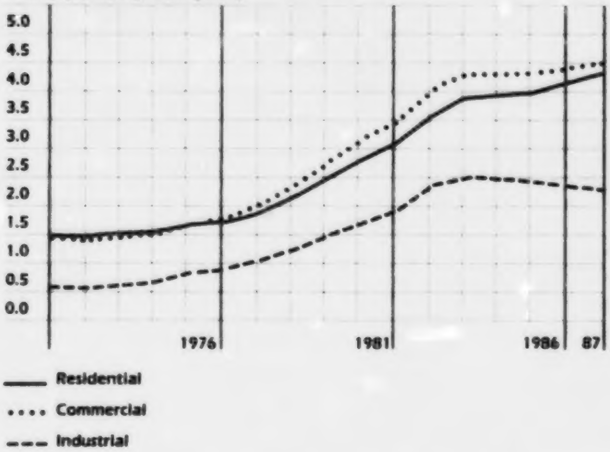


Table 4.10

AVERAGE SELLING PRICE OF ELECTRICITY BY PROVINCE 1971-1985

In cents per kWh

Year	Québec	Atlantic Provinces	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Canada[1]
1971	1.02	1.48	1.15	1.05	1.70	1.48	1.30	1.18
1972	0.99	1.49	1.18	1.04	1.63	1.46	1.27	1.18
1973	1.00	1.49	1.27	1.03	1.57	1.55	1.27	1.22
1974	1.06	1.66	1.37	1.16	1.58	1.66	1.41	1.31
1975	1.27	1.93	1.56	1.41	1.77	1.96	1.62	1.53
1976	1.35	2.10	1.81	1.70	2.14	2.39	1.78	1.73
1977	1.48	2.65	2.28	1.94	2.45	2.70	2.05	2.05
1978	1.69	3.23	2.41	2.32	2.71	3.11	2.22	2.27
1979	1.98	3.54	2.60	2.73	2.69	3.21	2.36	2.50
1980	2.23	3.73	2.91	2.78	2.93	3.40	2.62	2.75
1981	2.64	4.32	3.23	2.80	3.55	4.11	3.03	3.16
1982	3.09	4.99	3.61	2.93	4.02	4.86	3.85	3.66
1983	3.39	5.43	3.92	3.05	4.21	5.19	3.81	3.93
1984	3.39	5.70	4.20	3.36	4.50	5.44	4.06	4.11
1985	3.46	6.02	4.52	3.55	4.82	5.43	4.39	4.30

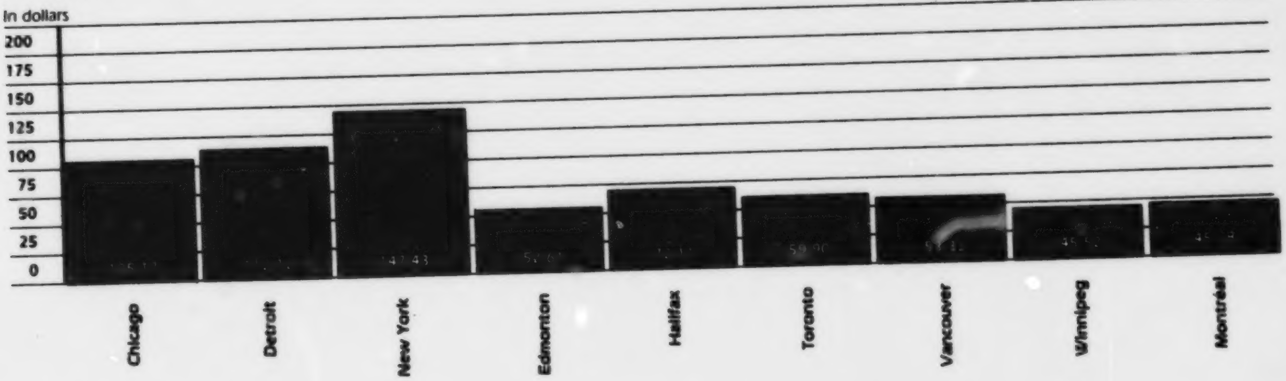
1. Including the Federal Territories.
Source: Statistics Canada, catalogue 57-202.

Graph 4.12

COMPARED ELECTRICITY PRICES IN QUÉBEC AND VARIOUS CITIES OF NORTH AMERICA

As of May 1, 1988

Residential use: monthly bill[1] for 1,000 kWh

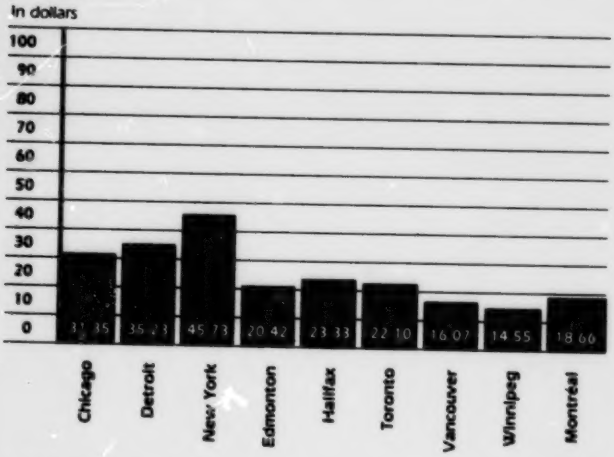


1. Does not include sales tax.
Source: Hydro-Québec.

Graph 4.13

COMPARED PRICES PER kW PER MONTH[1] AS CHARGED BY HYDRO-QUÉBEC AND CERTAIN CITIES IN NORTH AMERICA
As of May 1, 1988

Industrial use: medium power (minimum power 1,000 kW per month — minimum consumption 400,000 kWh per month)



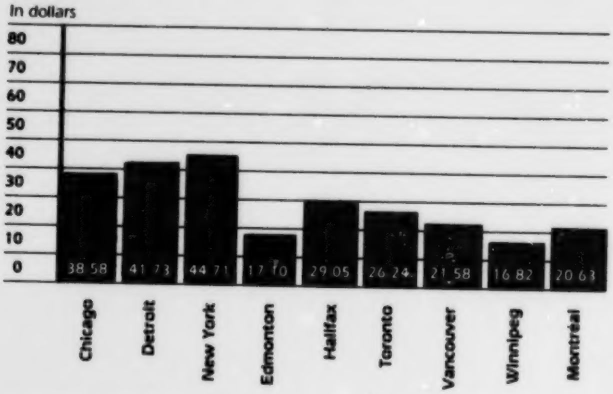
[1] Does not include sales tax.

Source: Hydro-Québec.

Graph 4.14

COMPARED PRICES PER kW PER MONTH[1] AS CHARGED BY HYDRO-QUÉBEC AND CERTAIN CITIES IN NORTH AMERICA
As of May 1, 1988

Industrial use: large power (minimum power 5,000 kW per month)



[1] Does not include sales tax.

Source: Hydro-Québec.

PRICE INDICATORS

Changes in the relative energy price index reflect the limited variations in the price of the various energy forms observed in 1987. The relative energy price index lost 1.6% in one year, compared to decreases of 7.2% in 1986 and 3.0% in 1985. This indicator, calculated for each consumption sector, reveals variations in energy prices in relation to the general evolution of prices. The evolution noted in 1987 thus indicates that energy prices decreased in relation to the general price level, and that this decrease in relative energy prices affected all consumption sectors.

In the residential sector, direct comparison between the price increase for the different forms of energy and that of several other goods shows that, in relation to 1981, the increase in energy prices was generally 4% lower than that for goods and services as a whole.

Still in relation to 1981, light fuel oil was the form of energy whose price increased most slowly, compared to electricity and natural gas. This is essentially due to the drop in crude oil prices recorded in 1986.

In the industrial sector, variations in energy prices had different effects on businesses, depending on their branch of activity. The relative share of energy costs in the production value was particularly high for industries involved in smelting and refining (16% in 1985), iron and steel (13%), paper and related products (11% and non-metallic mineral products (10%).

Table 4.11

RELATIVE ENERGY PRICE INDEX BY CONSUMPTION 1971-1987

Base 100: 1981

Year	Residential sector	Commercial sector	Transportation sector	Industrial sector	All sectors[1]
1971	68.3	72.2	89.8	80.0	78.0
1972	68.1	70.9	86.8	77.9	76.4
1973	70.9	72.3	87.2	80.5	78.3
1974	74.5	71.8	86.7	79.0	78.6
1975	72.9	70.8	82.9	78.1	76.8
1976	74.6	73.4	83.9	78.0	77.9
1977	77.2	77.3	81.8	80.8	79.7
1978	80.9	83.8	82.8	87.5	84.0
1979	84.5	89.0	78.9	91.6	86.1
1980	88.3	94.0	80.4	93.6	88.9
1981	100.0	100.0	100.0	100.0	100.0
1982	105.3	105.6	117.7 rd	110.0 rd	110.5 rd
1983	107.5	106.9	118.9 rd	116.3 rd	112.5 rd
1984	107.8	104.6	116.9 rd	112.0 rd	111.2 rd
1985	103.6	100.9	118.1 rd	106.3 rd	107.8 rd
1986	97.3 pd	96.2 pd	104.4 pd	99.6 pd	99.9 pd
1987	96.3 pd	94.0 pd	103.0 pd	97.6 pd	98.3 pd

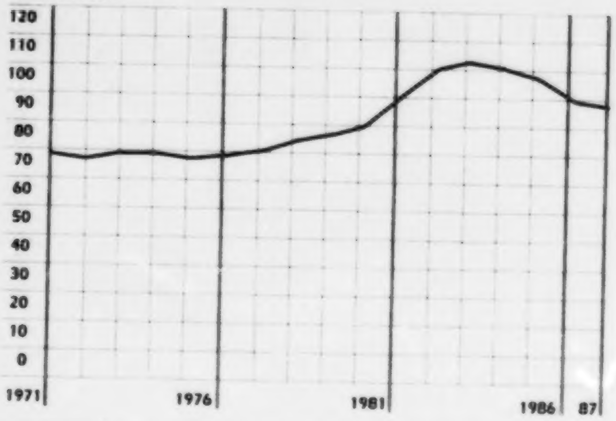
pd: preliminary data
rd: revised data

[1] The relative energy price index was obtained by first calculating the price index for each consumption sector. The energy price index for each sector was then divided by a specific price index — the consumer price index for the residential and commercial sectors, and the index for cost of capital and labor for the industrial and transportation sectors. The relative energy price index was then obtained by weighting the relative energy price indexes for the sectors according to the quantity of toe consumed per sector.

Graph 4.15

RELATIVE ENERGY PRICE INDEX

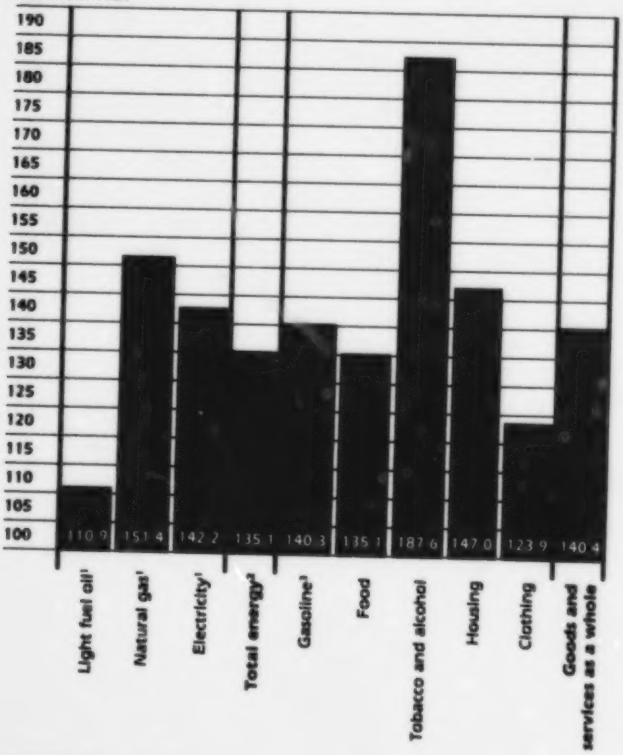
Base 100: 1981



Graph 4.16

ENERGY PRICE INCREASES COMPARED TO THOSE OF OTHER GOODS — 1987 PRICES IN MONTRÉAL

Base 100: 1981



1. Residential sector.
2. Includes all forms of energy consumed in the residential sector.
3. Regular leaded gasoline.

Sources: Statistics Canada, catalogue 62-010, and the ministère de l'Énergie et des Ressources du Québec.

Table 4.12

COST OF ENERGY PER DOLLAR OF OUTPUT FOR CERTAIN INDUSTRIES
1971-1985

In current dollars

Year	Mining	Paper and related products[1]	Iron and steel	Smelting and refining[1]	Nonmetallic mineral products	Total for these five groups	All mining and manufacturing industries
1971	0.04	0.07	0.05	0.23	0.06	0.09	0.03
1972	0.04	0.07	0.06	0.23	0.06	0.08	0.03
1973	0.05	0.06	0.06	0.20	0.07	0.08	0.02
1974	0.06	0.06	0.06	0.17	0.08	0.08	0.03
1975	0.05	0.07	0.07	0.18	0.07	0.08	0.03
1976	0.05	0.08	0.08	0.19	0.07	0.08	0.03
1977	0.06	0.08	0.09	0.17	0.08	0.09	0.03
1978	0.06	0.09	0.10	0.17	0.09	0.10	0.03
1979	0.06	0.09	0.10	0.16	0.10	0.09	0.03
1980	0.06	0.09	0.11	0.16	0.11	0.10	0.03
1981	0.08	0.09	0.11	0.20	0.11	0.11	0.03
1982	0.08	0.10	0.13	0.19	0.12	0.12	0.04
1983	0.08	0.12	0.13	0.17	0.11	0.12	0.04
1984	0.09 rd	0.12	0.11	0.16 rd	na	0.12[2] rd	0.04
1985	0.09	0.11	0.13	0.16	0.10	0.12	0.04

rd: revised data
na: not available

[1] This estimate includes producer-consumed energy.

[2] Does not include the nonmetallic mineral product industry.

COMPARATIVE ENERGY PRICES

In a period of shifting energy requirements, such as that experienced by Québec for the past several years, the relative position of the prices of different forms of energy is a key determinant of the sector's situation as a whole. The pace at which oil is being replaced, and the momentum gained by natural gas and electricity in market penetration are in large part related to the comparative prices of each of these forms of energy.

During the period from July 1987 to July 1988, there was an improvement in the competitive position of petroleum products, in relation to that of the other forms of energy. This was primarily due to the weakening of the international price of oil, noted since December 1987.

The following describes the situation as of July 1, 1988, broken down by consumption sector and the most relevant levels of energy use:

In the residential sector, dual-energy had an advantage over other forms of energy such as electricity, natural gas and light fuel oil for heating single-family homes. This advantage increased with the level of consumption.

In the commercial sector, dual-energy was the least expensive form of energy for apartment and commercial buildings. In the case of commercial buildings, there was a significant price difference in relation to the other forms of energy.

Finally, in the high-output industrial sector, natural gas had an advantage over electricity and heavy fuel oil, whether the gas was delivered on a firm or an interruptible service basis.

Table 4.13

COMPARATIVE ENERGY PRICES[1] IN MONTRÉAL
AS OF JULY 1, 1988

In thousand dollars per useful toe

	Natural gas	Electricity	Light fuel oil	Dual-energy (Electricity — light fuel oil)	Heavy fuel oil
Residential sector					
● Single-family dwelling					
— requiring 28,000 kWh[2]	0.498	0.530	0.518	0.433	
— requiring 14,000 kWh[2]	0.562	0.511	0.553	0.480	
Commercial sector					
● Apartment building (12 units)	0.432	0.540	0.397	0.283	
● Office building (13 floors)	0.385	0.577	0.299	0.240	
Industrial sector					
● High output industry					
— firm service	0.193	0.353			0.149
— interruptible service	0.149	0.125			0.122

1. Includes provincial sales tax where applicable.
2. For space heating purposes.
Source: Direction des etudes et statistiques of the ministère de l'Energie et des Ressources du Québec.

5. ECONOMIC IMPACT OF THE ENERGY SECTOR

THE ECONOMIC IMPACT OF ENERGY INDUSTRIES

The energy industries are an important sector of Québec's economy. In 1987, the value of energy expenditures in Québec amounted to 9.2% of gross domestic spending. In terms of absolute value, energy expenditures in 1987 reached $12 billion, an increase of 2.5% over 1986.

In 1986, 6.0% of overall household expenditures for goods and services were used to pay the energy bill. This marks a decrease for the fourth consecutive year; the share of energy in total per household expenditures for goods and services had been 6.7% in 1985.

In 1984, the value added of the energy sector represented 4.9% of Québec's gross domestic product. More recent data on the value added of the energy sector are not available, as Statistics Canada undertook a revision of Canadian financial statistics in 1986. It can again be stated that, as imports, oil and natural gas contribute basically very little to the value added, and that the contribution they do make is through refining, transmission and distribution activities. Electricity, on the other hand, plays a key role in gross domestic product figures, accounting for $3.7 billion, or 84% of the $4.4 billion gross domestic energy product in 1984. In absolute terms, electricity has contributed more than any other form of energy to the growth of Québec's gross domestic product since 1971. This contribution rose from 2.0% in 1975 to 4.1% in 1984.

The economic impact of the energy industries can be measured, not only in terms of their influence on the value added, but also in terms of the investments and employment they generate.

In 1987, for the first time in five years, for energy investments made in Québec in the energy sector were up. These investments reached $1.8 billion, or 6.8% over 1986. However, since the economy as a whole also rose sharply, the share of the energy sector in total investments fell slightly and stood at 7.6%.

The upturn in investments in the energy sector is mainly due to the growth of investments in the electricity sector In 1987, these investments reached $1.6 billion, an increase of 7.5% over 1986, and constituted 86.2% of the energy investments made in Québec, compared to 85.6% in 1986. In 1987, investments in the oil and natural gas sectors reached $188.3 million and $67.5 million, respectively.

Investments and operational expenditures have a considerable direct and indirect influence on Québec's overall economy. For example, Hydro-Québec's 1987 payroll was $938 million, and this government corporation purchased goods and services worth $1,448 million, most of which was spent in Québec.

Employment generated by the energy sector remained relatively modest because of the nature of energy industries, which require large amounts of capital. In fact, the major impact of these industries on employment lies within the energy sector narrowly defined and is tied to the construction of hydroelectric power plants, gas lines and refinery plants more than to the actual operation of these installations. In 1987, the overall energy sector provided jobs for 43,875 people. Hydro-Québec remained the most important employer with nearly 19,000 permanent jobs.

Table 5.1

VALUE OF ENERGY EXPENDITURES IN QUÉBEC COMPARED WITH GROSS DOMESTIC EXPENDITURE
1971-1987

Year	Total energy expenditures (millions of current dollars)	Gross domestic expenditure (millions of current dollars)	Share of energy expenditures in gross domestic expenditure (%)
1971	2,100	24,271	8.7
1972	2,349	27,217	8.6
1973	2,836	30,928	9.2
1974	3,356	36,342 rd	9.2
1975	3,781	40,944 rd	9.2
1976	4,409	47,697 rd	9.2
1977	4,975	52,211 rd	9.5
1978	5,783	58,122 rd	9.9
1979	6,509	64,939 rd	10.0
1980	7,588	72,220	10.5
1981	9,549	81,513 rd	11.7
1982	10,665	86,228 rd	12.4
1983	11,024	92,274 rd	11.9 rd
1984	11,763	100,962 rd	11.7
1985	12,024	109,076 rd	11.0 rd
1986	11,711	119,439 pd	9.8 pd
1987	11,998	130,421 pd	9.2 pd

pd: preliminary data
rd: revised data
Sources: Statistics Canada, catalogue 13-213, and the Bureau de la statistique du Québec.

Table 5.2

SHARE OF HOUSEHOLD EXPENDITURES ALLOTTED TO ENERGY
1971-1986

Year	Household expenditures for energy		Total household expenditures[1]	
	millions of current dollars	%	millions of current dollars	%
1971	883	6.2	14,226	100.0
1972	957	6.0	16,045	100.0
1973	1,073	5.8	18,442	100.0
1974	1,306	6.1	21,319	100.0
1975	1,484	6.0	24,814	100.0
1976	1,690	6.1	27,874	100.0
1977	1,806	5.8	30,935	100.0
1978	2,033	6.0	33,970	100.0
1979	2,300	6.0	38,075	100.0
1980	2,592	6.2	42,102	100.0
1981	3,305	7.0	46,927	100.0
1982	3,860	7.6	50,536	100.0
1983	4,010	7.2	55,324	100.0
1984	4,284	7.1	60,607	100.0
1985	4,452	6.7	66,138	100.0
1986	4,363	6.0	72,539	100.0

1. Source: Ministère de l'Industrie, du Commerce et du Tourisme du Québec.

Table 5.3

VALUE ADDED BY THE ENERGY SECTOR IN THE GROSS DOMESTIC PRODUCT
1971-1984

Year	Oil and coal sector (millions of current dollars)	Electricity sector (millions of current dollars)	Natural gas sector (millions of current dollars)	Gross domestic product of the energy sector (millions of current dollars	Total gross domestic product for overall economy (millions of current dollars)	Share of the energy sector in total gross domestic product (%)
1971	71.5	470.3	29.5	571.3	20,697.0	2.76
1972	80.6	493.3	30.8	604.7	23,171.0	2.61
1973	97.8	546.7	33.2	677.7	26,552.0	2.55
1974	117.1	633.0	41.6	791.7	31,978.0	2.48
1975	169.0	731.8	43.3	944.1	36,977.0	2.55
1976	150.3	855.0	51.0	1,056.3	42,362.0	2.49
1977	217.5	1,034.7	49.4	1,301.6	46,333.0	2.81
1978	116.5	1,301.9	54.2	1,472.6	51,505.0	2.86
1979	245.2	1,684.3	62.3	1,991.8	58,265.0	3.42
1980	301.4	2,123.4	69.6	2,494.4	65,990.0	3.78
1981	255.0	2,487.7	78.1	2,820.8	73,819.0	3.82
1982	305.0 rd	2,895.3 rd	104.2 rd	3,304.5 rd	76,238.0	4.33 rd
1983	374.7 rd	3,256.9 rd	140.8 rd	3,772.4 rd	81,165.0	4.65 rd
1984	494.5 rd	3,713.3 rd	198.7 rd	4,406.5 rd	89,593.0 rd	4.92 rd

rd: revised data
Source: Statistique Canada, catalogues 13-213 et 61-202.

Table 5.4

INVESTMENTS IN THE ENERGY SECTOR
1971-1987

Year	Oil and coal industries[1] (millions of current dollars)	Electricity industry[2] (millions of current dollars)	Natural gas industry[3] (millions of current dollars)	Energy sector total (millions of current dollars)	Investments in overall economy (millions of current dollars)	Share of energy investments in total investments (%)
1971	87.1	388.6	10.1	485.8	4,149.9	11.71
1972	108.2	423.8	13.4	545.4	4,824.3	11.30
1973	78.8	550.7	11.2	640.7	5,826.5	11.00
1974	106.2	615.8	18.3	740.3	7,398.2	10.01
1975	108.8	1,141.8	23.0	1,273.6	9,170.4	13.89
1976	95.8	1,269.2	15.4	1,380.4	9,813.0	14.07
1977	85.3	1,958.5	21.0	2,064.8	10,702.3	19.29
1978	95.2	2,592.5	16.2	2,703.9	10,793.9	25.05
1979	116.9	2,825.4	25.2	2,967.5	11,854.2	25.03
1980	116.7	2,593.9	31.1	2,741.7	12,818.9	21.39
1981	176.1	2,671.6	212.1	3,059.8	13,739.2	22.27
1982	283.1	2,550.1	254.4	3,087.6	13,097.5	23.57
1983	259.6	2,176.7	424.3	2,860.6	13,947.1	20.51
1984	172.4	1,604.3	390.8	2,167.5	15,747.8	13.76
1985	139.6	1,541.7	219.2	1,900.5	19,240.0	9.88
1986	142.8 rd	1,479.5	106.8	1,729.1 rd	21,029.5 rd	8.22 rd
1987	188.3 pd	1,591.2	67.5	1,847.0 pd	24,178.5 pd	7.64 pd

pd: preliminary data
rd: revised data

1. Including oil exploration, oil refining and petroleum product distribution industries.
   Sources: Statistics Canada, catalogue 61-205, unpublished data from Statistics Canada, and the Direction de l'aménagement of the ministère de l'Énergie et des Ressources du Québec.
2. Including Hydro-Québec and, from 1976 on, private producers.
   Sources: Direction information de gestion et statistique, Hydro-Québec; and annual reports filed by private producers with the Régie de l'électricité et du gaz.
3. Before 1980, this section includes only the investments made by TransCanada PipeLines Ltd. and Gaz Métropolitain, inc.
   Sources: Annual reports of Gaz Métropolitain, inc., TransCanada PipeLines Ltd., Trans Québec & Maritimes inc., Soquip, presentation made by Trans Québec & Maritimes inc. to the National Energy Board and unpublished data from TransCanada Pipelines Ltd., from Gaz Inter-Cité Québec inc., Le Gaz Provincial du Nord de Québec ltée and Gazifère inc.

Graph 5.1

SHARE OF ENERGY INVESTMENTS IN TOTAL INVESTMENTS

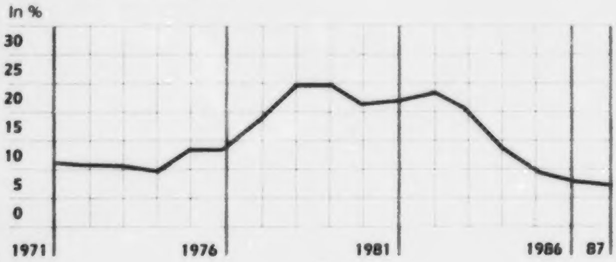


Table 5.5

DIRECT AND INDIRECT ECONOMIC EFFECTS OF HYDRO-QUÉBEC'S ACTIVITIES
1979-1987

In millions of current dollars

Year	Gross salaries[1]	Purchase of goods and services[2]	Total
1979	526	964	1,490
1980	621	1,076	1,697
1981	718	1,274	1,992
1982	782	1,129	1,911
1983	776	816	1,592
1984	847	1,026	1,873
1985	917	1,327	2,244
1986	882	1,350	2,232
1987	938	1,448	2,386

1. Includes the salaries of employees on project sites and those of S.E.B.J. employees.
2. Includes purchases made through the company order system.

Source: Annual reports of Hydro-Québec, and the Direction de la comptabilité, Hydro-Québec.

Table 5.6

EMPLOYMENT IN THE ENERGY SECTOR
1971-1987

Year	Oil and coal sector[1] (number of jobs)	Petroleum product distribution sector[2] (number of jobs)	Hydro-Québec[3] (number of jobs)	Natural gas sector[4] (number of jobs)	Total employment in the energy sector (number of jobs)	Total employment in the economy[5] (number of jobs)	Share of energy in total employment (%)
1971	3,145	na	12,245	1,127	16,517	2,176,000	0.76
1972	3,087	na	12,627	1,116	16,830	2,208,000	0.76
1973	3,056	na	13,027	1,088	17,171	2,330,000	0.73
1974	3,254	na	13,679	1,106	18,039	2,401,000	0.75
1975	3,375	na	14,543	1,133	19,051	2,434,000	0.78
1976	3,403	na	14,969	1,028	19,400	2,456,000	0.78
1977	3,880	na	15,763	1,028	20,671	2,476,000	0.83
1978	4,243	na	16,930	1,010	22,183	2,530,000	0.88
1979	3,618	na	17,880	1,013	22,511	2,619,000	0.86
1980	3,683	30,718	18,635	1,044	54,080	2,694,000	2.01
1981	4,087	29,668	19,482	1,582	54,819	2,726,000	2.01
1982	4,034	28,368	19,959	1,686	54,047	2,584,000	2.09
1983	3,217	28,187	18,975	1,690	52,069	2,642,000	1.97
1984	3,030	27,430	18,560	1,708	50,728	2,722,000	1.86
1985	3,097	26,070	18,208	1,716	49,091	2,804,000	1.75
1986	3,357	25,102	18,470	1,517	48,446	2,866,000	1.73
1987	3,021	20,421	18,933	1,500	43,875	2,966,000	1.48

na: not available

1. Total employment in manufacturing sector.
   Source: Statistics Canada, catalogues 31-203 and 72-002.
2. Employment related to wholesale and retailing of energy petroleum products.
   Source: Direction des produits pétroliers of the ministère de l'Énergie et des Ressources du Québec.
3. Permanent employees of all subsidiaries, including the Société d'énergie de la Baie James, excluding employees on project sites.
   Source: Annual reports of Hydro-Québec.
4. Before 1981, this section includes only the permanent employees of Gaz Métropolitain, inc.
   Sources: Annual reports of Gaz Métropolitain, inc. and Trans Québec & Maritimes inc., and unpublished data from Gaz Inter-Cité Québec inc. and Trans Québec & Maritimes inc.
5. Source: Statistics Canada, catalogues 71-001 and 71-529.

THE STRUCTURING EFFECT OF ENERGY AVAILABILITY

The availability of diversified, competitive sources of energy plays a major role in Québec's economic expansion. The five high energy consumption groups which, alone, account for nearly 80% of industrial energy consumption, produce almost one third of the industry's value added and employ almost one quarter of the manpower. Electricity is a determining entrant in industries which produce paper and related products, as well as in ore processing (iron and steel, smelting and refining of aluminium, copper, etc.). Natural gas plays an important role in ore processing and in the manufacture of paper and related products, as well as in the chemical industry.

Oil continues to enjoy considerable importance throughout the industrial sector, especially in mining, paper and related products, and ore processing.

The availability of large quantities of electricity at competitive prices explains Québec's place on the international aluminum market. In 1986, Québec ranked third among aluminum producers, behind the United States and the USSR, and produced 7% of the world's aluminum.

Table 5.7

IMPORTANCE OF HIGH ENERGY CONSUMING INDUSTRIES IN QUÉBEC'S ECONOMY
1984

In % of total mining and manufacturing industries

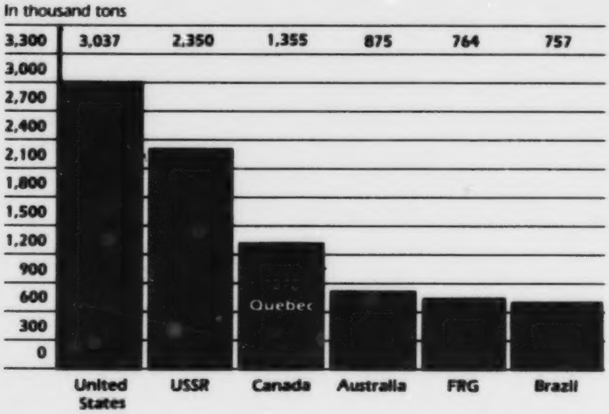
Industrial group	Energy intensity[1]	Value added	Number of employees	Energy consumption	Electricity consumption	Natural gas consumption	Oil consumption
		%	%	%	%	%	%
Mining	0.83	4.57	3.28	7.97	4.69	0.00	15.81
Paper and related products	1.33	12.04	8.20	33.65	36.18	12.87	35.80
Ore processing	1.87	8.26	5.53	32.38	38.90	18.72	13.17
Nonmetallic mineral products	cd	cd	cd	cd	cd	3.52	cd
Chemical industry	0.37	6.15	4.87	4.76	6.12	11.80	2.80
Total		**31.02**	**21.88**	**78.76**	**85.89**	**46.91**	**67.58**

cd: confidential data

1. As measured in the ratio between consumption, expressed in toe, and the value added, expressed in thousands of 1981 constant dollars.

Graph 5.2

MAJOR ALUMINUM PRODUCER COUNTRIES[1] IN THE WORLD
1986



[1] Primary aluminum ingots.

Source: Direction générale de l'industrie minérale of the ministère de l'Énergie et des Ressources du Québec.

THE ENERGY SECTOR BALANCE OF TRADE

The rise in crude oil prices, added to the increase in the volume of petroleum product imports, was the major factor responsible for the deterioration of the balance of trade in Québec's energy sector in 1987. The cost of crude oil imports rose from $2.1 billion in 1986 to $2.3 billion in 1987, an increase of nearly 10%. Québec's total energy imports climbed to $4.3 billion, compared to $4.1 billion in 1986.

The volume of electricity sales outside Québec increased by nearly 10% ($713 million, compared to $649 million in 1986). On the other hand, the rise in the prices of petroleum products, despite the reduction in volumes exported, contributed to keep the revenues from petroleum product exports roughly at the same level as in 1986 ($799 million in 1987, compared to $791 in 1986).

In all, 1987 saw a slight drop in Québec's balance of trade in the energy sector. In relation to 1986, the deficit rose from $2.5 billion to $2.7 billion, a jump of nearly $200 million. Calculated in current dollars, the balance for 1987 — after that of 1986 — was the best since 1978.

Table 5.8

ENERGY SECTOR BALANCE OF TRADE
1971-1987

In millions of current dollars

	Coal[1]		Crude oil[2]		Petroleum products[3]		Natural gas[4]		Electricity[5]		Energy sector balance of trade
Year	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	**Imports**	**Exports**	
1971	20		512		129	162	27	1	ε	22	– 503
1972	19		593		138	214	29	1	16	28	– 552
1973	21		798		136	228	35	1	46	47	– 760
1974	23		1,363		225	258	52	2	74	78	– 1,399
1975	43		1,494		252	352	87	5	99	92	– 1,526
1976	41		1,855		232	420	122	7	104	89	– 1,838
1977	34		2,241		304	575	148	9	110	102	– 2,151
1978	39		2,524		328	583	191	10	115	129	– 2,475
1979	31		2,729		412	383	222	13	118	221	– 2,895
1980	51		3,358		466	510	278	20	119	300	– 3,442
1981	40		4,795		590	905	381	26	117	375	– 4,617
1982	44		5,124		612	1,191	452	27	117	474	– 4,657
1983	44		4,460		1,048	1,217	559	25	111	528	– 4,452
1984	51		4,197		1,100	1,099	646	26	154	646	– 4,377
1985	58		3,976	124	1,050	1,263	742	28	118	673	– 3,856
1986	68		2,176 rd	90 rd	966 rd	791 rd	744	20	115	649	– 2,519 rd
1987	67		2,320 pd	69 pd	1,115 pd	799 pd	708	14	110	713	– 2,725 pd

pd: preliminary data
rd: revised data

1. Includes coal and coke.
   Source: Statistics Canada, catalogues 57-208, 57-506, 57-003 and 45-002, and unpublished data from Statistics Canada on Québec's external trade.
2. Sources: Statistics Canada, catalogue 57-003 and monthly reports published by Canadian Enerdata.
3. Includes the following energy-related petroleum products: gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke and liquefied petroleum gas from primary and secondary sources.
   Source: Statistics Canada, catalogues 57-003, 45-004, 45-209, 65-702 and 65-203.
4. Sources: Direction des études et statistiques of the ministère de l'Énergie et des Ressources du Québec, and Statistics Canada, catalogues 57-003, 55-202 and 65-202.
5. Sources: Service de la comptabilité des résultats d'exploitation, Hydro-Québec, and Statistics Canada, catalogue 57-202.
6. Including electricity purchased from Churchill Falls.

ENERGY INDUSTRIES

6. ELECTRICITY

PRODUCTION

In Québec, electricity is the major source of energy that is purely domestic in origin. As of January 1, 1988, Québec's installed generating capacity was 32,661 MW, or virtually the same as on January 1, 1987. About three quarters (75.1%) of this installed capacity in Québec was under the direct control of Hydro-Québec, which had 79 generating stations located throughout the province. The remaining installed generating capacity came from private companies (9.7% of the total) and municipalities (0.1%), or was available under a long-term delivery agreement between Hydro-Québec and the company that administers the Churchill Falls installations in Labrador (15.1%).

The majority of the generating stations in this production pool are hydroelectric, while the others include thermal power plants that generate electricity from petroleum products (conventional thermal plants, internal combustion or gas turbine plants) and one nuclear power plant, Gentilly 2. The La Grande River power complex alone generates 10,282 MW. In 1986, it was the fourth largest hydroelectric complex in the world, after Itaipu (Brazil), Grand Coulee (United States) and Guri (Venezuela). Moreover, the La Grande 2 power complex is Québec's leading generating station with an installed capacity of 5,328 MW, about one sixth of Québec's total available installed capacity.

Over the past fifteen years, Québec's electricity production network has expanded very rapidly. Between 1971 and 1987, Hydro-Québec almost tripled its electricity output, growing from 54 billion kWh to 137.7 billion kWh. This production is essentially the result of phase 1 of the La Grande complex development project. In 1987, the electricity produced by Hydro-Québec represented nearly three quarters of all the electricity produced in Québec, including supplies from Churchill Falls.

Thanks to Québec's resources, Canada ranked first among hydroelectricity producing countries in 1985. That year, with all the electricity available from Hydro-Québec and the private companies, Québec alone was the fourth largest hydroelectricity producer in the world, behind the United States, U.S.S.R. and Brazil.

It was on January 14, 1988, that the Hydro-Québec network recorded its maximum power inrush. For Hydro-Québec, this peak corresponds to priority demand. Firm demand rose to 26,005 MW, an increase of 2,786 MW over the power inrush recorded one year earlier, on January 26, 1987. During the peak demand, exports and sales of surplus Hydro-Québec electricity reached 2,241 MW.

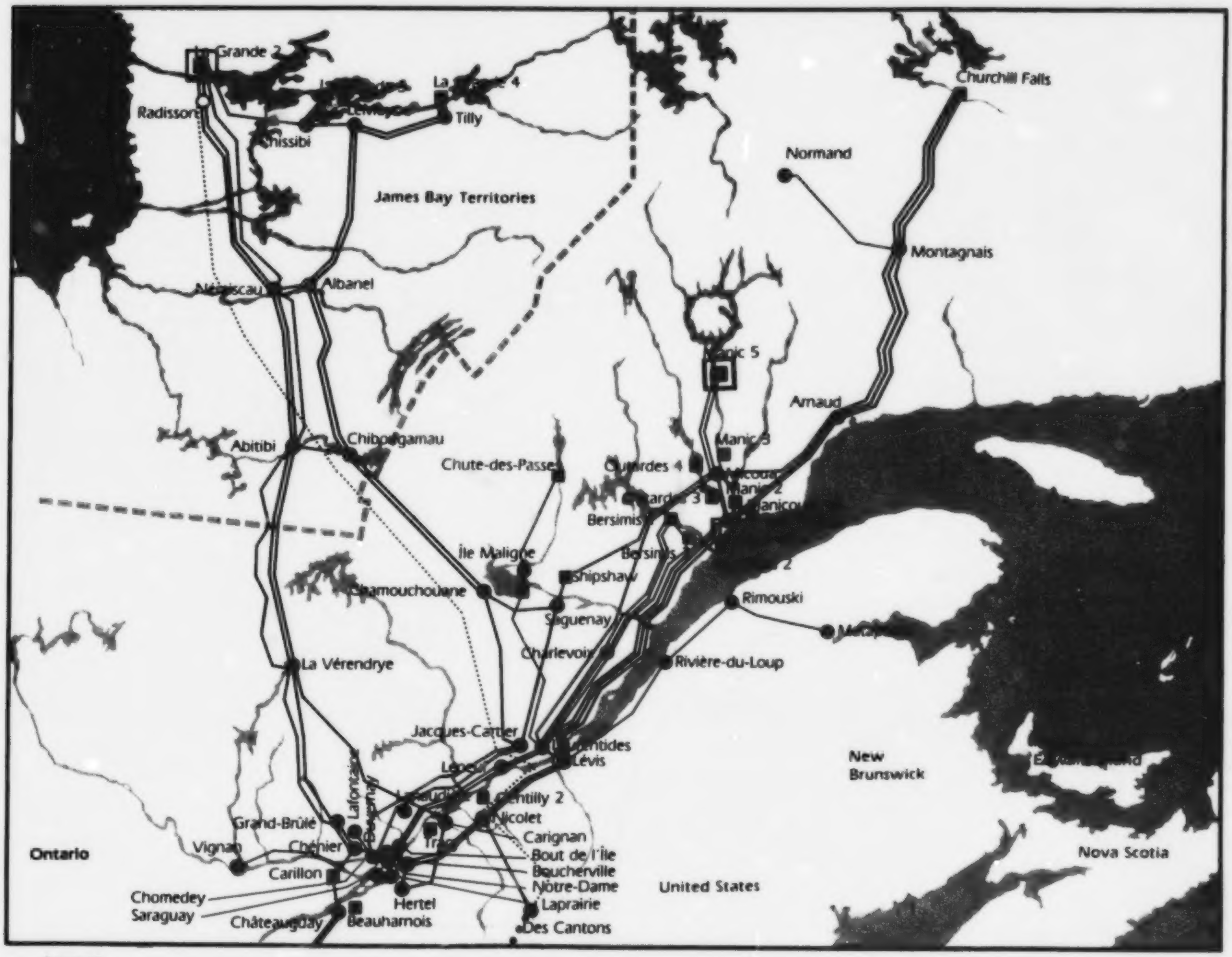
In 1987 alone, Hydro-Québec had access to 30.4 billion kWh generated by Churchill Falls, and 20.8% of the electricity consumed in Québec came from this source. It was in May 1969 that Hydro-Québec concluded an agreement with Churchill Falls (Labrador) Corporation Ltd., a company in which it owns 34.2% of the shares. This agreement, which provides for the sale to Hydro-Québec of electricity produced by the Churchill Falls complex, extends over a forty-year period, with automatic renewal for an additional twenty-five years. In June 1988, following litigation by the government of Newfoundland that lasted nearly fifteen years, the Supreme Court of Canada confirmed Hydro-Québec's rights over the energy produced at Churchill Falls.

Québec's basic undeveloped hydraulic potential is estimated at about 40,000 MW, and can be broken down according to the size of the generating stations in question. The installation of plants of less than 100 MW would allow utilization of an estimated potential of 10,000 MW. For plants of 100 MW or more, suitable sites are still available, with a potential of about 30,000 MW (given a utilization rate of 80%) — of which 14,000 MW are currently considered to be economically feasible.

Québec also has a number of sites on which peak hydroelectric facilities could be built. Such facilities would provide an estimated 18,000 MW.

Graph 6.1

PRODUCTION AND TRANSMISSION OF ELECTRICITY IN QUÉBEC AS OF JANUARY 1, 1987


Grande 2
La Grande 4
Radisson
Chissibi
Tilly
Churchill Falls
Normand
James Bay Territories
Montagnais
Nemiscau
Albanel
Manic 5
Arnaud
Abitibi
Chibougamau
Manic 3
Chute-des-Passes
Outardes 4
Micoudan
Manic 2
Outardes 3
Manicouagan
Bersimis
Bersimis 2
Île Maligne
Shipshaw
Chamouchouane
Rimouski
Saguenay
Metapedia
Charlevoix
La Vérendrye
Rivière-du-Loup
Jacques-Cartier
Laurentides
Lévis
New Brunswick
Lafontaine
Duvernay
Gentilly 2
Nicolet
Grand-Brûlé
Carignan
Vignan
Chénier
Bout de l'Île
Ontario
Carillon
Boucherville
Notre-Dame
United States
Nova Scotia
Chomedey
Hertel
Laprairie
Saraguay
Châteauguay
Beauharnois
Des Cantons

Legend

■ Operational power plant of 300 MW or more

▣ Additional capacity

— 315-kV and 345-kV line in operation

••• ± 450-kV continuous supply line in operation

— 735-kV line in operation

▬ 765-kV line in operation

······ ± 450-kV continuous supply line under construction

● 315-kV and 345-kV operational station

● 735-kV operational station

○ 735-kV station under construction

Table 6.1

POWER PLANTS IN OPERATION IN QUÉBEC AS OF JANUARY 1, 1988

HYDROELECTRIC POWER PLANTS

Power plant	Generating capacity (kW)	Owner
La Grande 2	5,328,000	Hydro-Québec
La Grande 4	2,650,500	Hydro-Québec
La Grande 3	2,304,000	Hydro-Québec
Beauharnois	1,645,810	Hydro-Québec
Manic 5	1,292,000	Hydro-Québec
Manic 3	1,183,200	Hydro-Québec
Manic 2	1,015,200	Hydro-Québec
Bersimis 1	924,000	Hydro-Québec
Outardes 3	756,200	Hydro-Québec
Chute-des-Passes	742,500	Alcan
Shipshaw	717,000	Alcan
Bersimis 2	683,600	Hydro-Québec
Carillon	654,500	Hydro-Québec
Outardes 4	632,000	Hydro-Québec
Outardes 2	453,900	Hydro-Québec
Île Maligne	336,000	Alcan
McCormick	303,750	Hydroélectrique Manicouagan
Trenche	297,000	Hydro-Québec
Beaumont	243,000	Hydro-Québec
Paugan	236,350	Hydro-Québec
La Tuque	220,000	Hydro-Québec
Rapide Blanc	189,600	Hydro-Québet
Chute à la Savanne	187,250	Alcan
Chute du Diable	187,250	Alcan
Manic 1	184,410	Hydro-Québec
Shawinigan 2	182,300	Hydro-Québec
Chute-à-Caron	180,000	Alcan
Shawinigan 3	171,900	Hydro-Québec
Les Cèdres	162,000	Hydro-Québec
Grand-Mère	149,575	Hydro-Québec
Rapides des Îles	146,520	Hydro-Québec
Chelsea	144,000	Hydro-Québec
La Gabelle	136,580	Hydro-Québec
Première Chute	124,200	Hydro-Québec
Rapides Farmers	98,250	Hydro-Québec
Masson	95,200	Énergie Maclaren-Québec
Rapides des Quinze	90,000	Hydro-Québec
Chute des Chats	89,300	Hydro-Québec
High-Falls	85,000	Énergie Maclaren-Québec
Bryson	61,000	Hydro-Québec
Rapide 7	57,000	Hydro-Québec
Murdock Willson	51,000	Price ltée
Jim Gray	51,000	Price ltée
Hart Jaune	48,450	Hydro-Québec
Rivière des Prairies	48,300	Hydro-Québec
Rapide 2	48,000	Hydro-Québec
Chute Dufferin	38,250	Énergie Maclaren-Québec
Chicoutimi	32,000	Centrale S.P.C. inc.
Chute Hemmings	28,800	Hydro-Québec
Hull 2	27,280	Hydro-Québec
Sept Chutes	18,720	Hydro-Québec
Sainte-Marguerite	17,600	Gulf Power Company
Saint-Narcisse	15,000	Hydro-Québec
Drummondville	14,600	Hydro-Québec
Chute-aux-Galets	13,600	Price ltée
Chute des Chaudières	11,750	E.B. Eddy ltée
Chicoutimi	9,900	Price ltée
W.R. Beatty	9,080	Pembroke Electric Light
Buckingham	8,588	Erco ltée
Mitis 1	6,400	Hydro-Québec
Adam Cunningham	6,375	Price ltée
Pont-Arnaud	5,450	Hydro-Québec
Lachute	5,100	Ayers ltée
Chute Bell	4,800	Hydro-Québec
Kénogami	4,690	Price ltée
Mitis 2	4,250	Hydro-Québec
Jonquière 1	4,092	Ville de Jonquière
Westbury	4,000	Ville de Sherbrooke
Weedon	3,120	Ville de Sherbrooke
Saint-Alban	3,000	Hydro-Québec
Saint-Raphaël	2,550	Hydro-Québec
Chute MacDougall	2,400	Papier journal Domtar
Jonquière Mill	2,400	Pulpe de Jonquière
Mont-Laurier	2,360	Placage de Bellerive ltée
Winneway	2,338	Ville de Belleterre
Sherbrooke	2,256	Hydro-Québec
Chute Garneau	2,240	Hydro-Québec
Corbeau	2,000	Hydro-Québec
Magog	2,000	Dominion Textile inc.
Chute Bird's Mill	1,920	Papier journal Domtar
Rock Forest	1,880	Ville de Sherbrooke
Magpie	1,800	Hydro-Québec
Rawdon	1,720	Hydro-Québec
Chute Burroughs	1,600	Hydro-Québec
Frontenac	1,600	Ville de Sherbrooke
Belding	1,440	Ville de Coaticook
Paton	1,440	Ville de Sherbrooke
Magog	1,197	Ville de Magog
Maquatua	1,100	Bande de Wemindji
Forestville	1,000	Papeterie Reed ltée
Drummond	880	Ville de Sherbrooke
Grand Baie 1	828	Consolidated-Bathurst inc.
Eustis	700	Ville de Sherbrooke
Penman	600	Ville de Coaticook
Saint-Paul	520	Ville de Coaticook
Grand Baie 2	460	Consolidated-Bathurst inc.
Anse-Saint-Jean	400	Hydro-Québec
Rivière-du-Loup	340	Pâte à Papier Mohawk ltée
Chemin du Lac	200	Pâte à Papier Mohawk ltée
Ruisseau Vassale	20	Parc des Alcaniens Shawinigan inc.
Rivière Noire	10	Club Bataram Plongeon
Hydroelectric power plant total	**25,925,239**	

In addition, most of the production of the generating station in Churchill Falls, Labrador, was available to Québec under long-term contract.

Churchill Falls	*5,225,000*	*Labrador Corp. Ltd*

Table 6.1 (continued)

POWER PLANTS IN OPERATION IN QUÉBEC AS OF JANUARY 1, 1988

THERMAL POWER PLANTS		
Power plant	**Generating capacity (kW)**	**Owner**
Conventional[1]		
Tracy	600,000	Hydro-Québec
Saint-Félicien	25,300	Donohue Saint-Félicien inc.
Kénogami	14,750	Price ltée
Drummondville	7,500	Celanese Canada inc.
Chandler	6,000	Gaspesia ltée
Murdochville	5,400	Mines Gaspé ltée
Noranda Smelter	4,100	Noranda Mines
Trois-Rivières	1,000	Canadian International Paper Co.
Gas turbine[2]		
La Citière	200,880	Hydro-Québec
Cadillac	162,000	Hydro-Québec
Internal combustion[3]		
Îles-de-la-Madeleine	59,269	Hydro-Québec
Blanc-Sablon	8,000	Hydro-Québec
La Tabatière	5,500	Hydro-Québec
Havre Saint-Pierre	3,350	Fer et Titane du Québec inc.
Saint-Augustin	3,000	Hydro-Québec
Murdochville	2,900	Mines Gaspé ltée
La Romaine	2,800	Hydro-Québec
Kuujjuaq	2,400	Hydro-Québec
Poste-de-la-Baleine	2,400	Hydro-Québec
Natashquan	2,100	Hydro-Québec
Port-Menier	2,100	Hydro-Québec
Povungnituk	1,800	Hydro-Québec
Île d'Entrée	1,740	Hydro-Québec
Inukjuak	1,620	Hydro-Québec
Salluit	1,200	Hydro-Québec
Kangirsuk	1,050	Hydro-Québec
Kangiqsualujjuaq	1,030	Hydro-Québec
Ivujivik	975	Hydro-Québec
Quaqtaq	930	Hydro-Québec
Kangiqsujuaq	820	Hydro-Québec
Johan-Beetz	605	Hydro-Québec
Akulivik	600	Hydro-Québec
Aupaluk	550	Hydro-Québec
Tasiujaq	440	Hydro-Québec
Clova	375	Électro Clova ltée
Nuclear		
Gentilly 2	685,000	Hydro-Québec
Thermal power plant total	**1,810,484**	

1. Using heavy fuel oil.
2. Using light fuel oil.
3. Using diesel fuel.

Sources: Hydro-Québec and Direction de l'aménagement of the ministère de l'Énergie et des Ressources du Québec.

Table 6.2

POWER PLANTS IN OPERATION AS OF JANUARY 1, 1988

	kW
Hydro-Québec	
Hydroelectric	22,793,511
Thermal	1,739,809
Hydro-Québec total	**24,533,320**
Private producers	
Hydroelectric	3,131,728
Thermal	70,675
Private producers total	**3,202,403**
Total (Hydro-Québec and private producers)	**27,735,723**
Churchill Falls	
Hydroelectric	4,925,000[1]
Churchill Falls total	**4,925,000**
Total available power	**32,660,723**

1. Available to Hydro-Québec under long-term contract.

Table 6.3

POWER PLANTS UNDER CONSTRUCTION IN QUÉBEC AS OF JANUARY 1, 1988

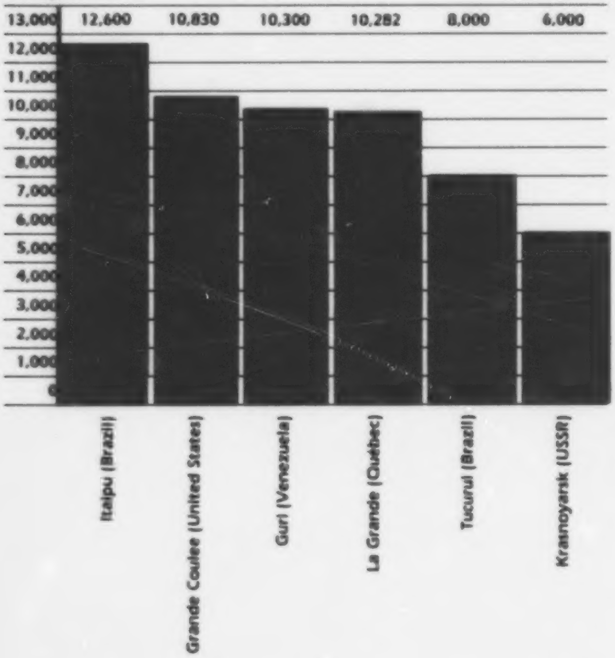
Power plant	Generating capacity (kW)	Type	Owner
La Grande 2 (additional capacity)	1,900,000	hydroelectric	Hydro-Québec
Manic 5 (additional capacity)	1,056,000	hydroelectric	Hydro-Quebec

Source: Hydro-Québec.

Graph 6.2

MAJOR HYDROELECTRIC COMPLEXES IN THE WORLD 1986

In megawatts

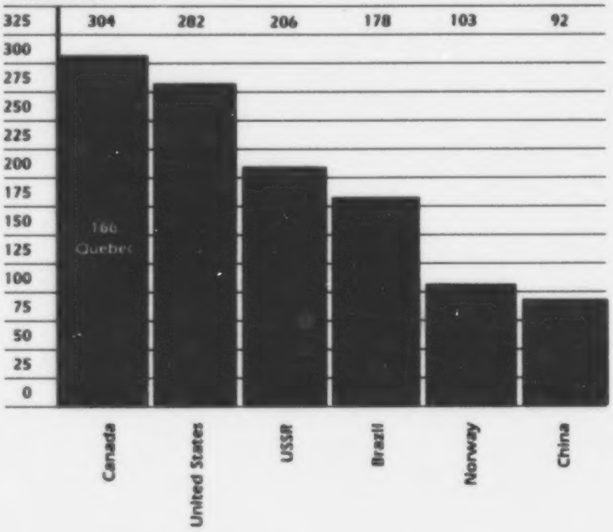


Sources: International Water Power and Dam Construction, and ministère de l'Énergie et des Ressources du Québec.

Graph 6.3

MAJOR HYDROELECTRICITY PRODUCER COUNTRIES IN THE WORLD 1985

In billion kWh



Sources: Energy Statistics Yearbook, United Nations, and ministère de l'Énergie et des Ressources du Québec.

Table 6.4

ELECTRICITY PRODUCTION IN QUÉBEC
1971-1987

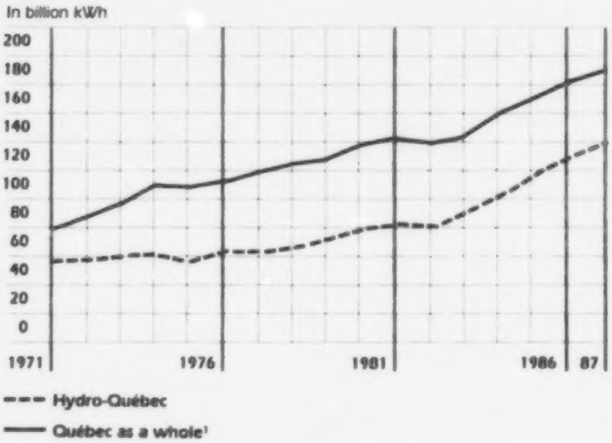
	Hydro-Québec		Québec as a whole[3]
Year	Installed capacity[1] (MW)	Production[2] (million kWh)	Production (million kWh)
1971	11,107	54,339	76,431
1972	11,107	55,906	85,266
1973	11,148	57,750	94,226
1974	11,123	60,189	106,331
1975	11,356	54,623	105,632
1976	12,409	61,206	109,348
1977	12,523	61,268	116,474
1978	12,979	63,329	122,915
1979	14,475	70,368	124,275
1980	16,862	76,494	135,618
1981	18,552	80,581	139,099
1982	19,142	78,821	135,787
1983	21,301	88,321	141,750
1984	23,480	100,343	158,241
1985	23,510	115,538	168,902
1986	24,475	128,078	179,653
1987	24,553	137,730	187,952

1. As of December 31 each year.
2. Includes electricity consumed by the generating station.
3. Besides the production directly ensured by Hydro-Québec, includes electricity produced by municipalities and private companies, as well as electricity from Churchill Falls.

Sources: Hydro-Québec and ministère de l'Énergie et des Ressources du Québec.

Graph 6.4

ELECTRICITY PRODUCTION IN QUÉBEC
1971-1987



1. Besides the production directly ensured by Hydro-Québec, includes electricity produced by municipalities and private companies, as well as electricity from Churchill Falls.

Table 6.5

PEAK DEMAND ON HYDRO-QUÉBEC NETWORK[1]
1971-1987

In megawatts

Year	Priority demand[2]	Overall demand[3]	Date of maximum inrush
1971	9,435	9,801	December, 20 1971
1972	10,244	10,956	December, 19 1972
1973	11,446	13,181	December, 17 1973
1974	11,932	13,508	December, 17 1974
1975	13,337	14,668	December, 19 1975
1976	14,783	15,806	December, 13 1976
1977	15,785	15,887	December, 12 1977
1978	17,059	17,488	February, 14 1979
1979	17,582	17,698	January, 24 1980
1980	19,385	19,508	January, 4 1981
1981	19,696	20,263	January, 18 1982
1982	18,379	20,189	January, 4 1983
1983	19,788	21,961	December, 20 1983
1984	22,406	25,487	January, 21 1985
1985	22,895	25,745	January, 15 1986
1986	23,219	26,004	January, 26 1987
1987	26,005	28,246	January, 14 1988

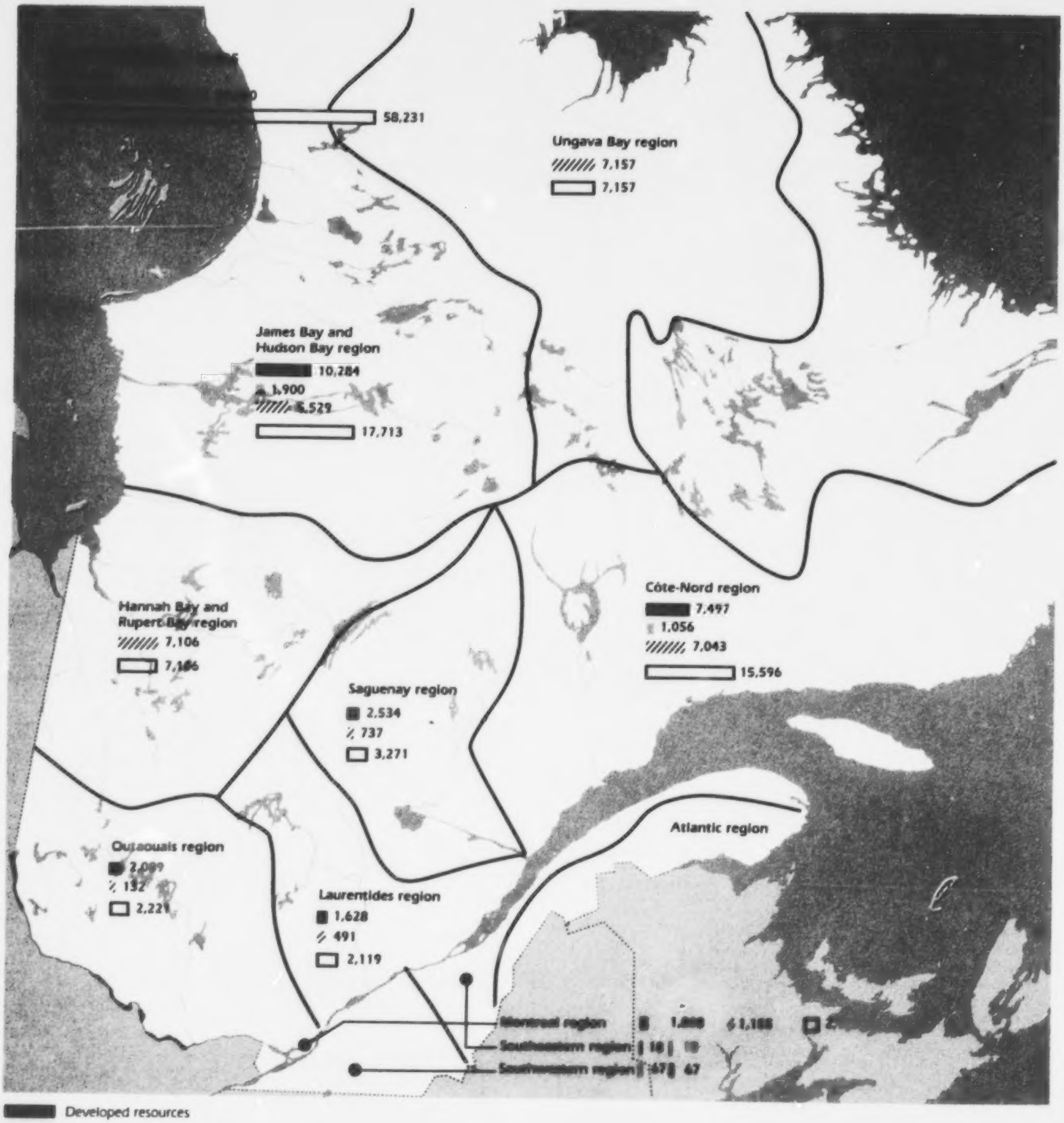
1. During maximum inrush beginning in December of each year.
2. Electricity which, under its mandate, Hydro-Québec must provide to its Québec consumers.
3. Priority demand, plus exports, surplus sales within Québec, contract interruptions, and losses.

Source: Hydro-Québec.

Graph 6.5

QUÉBEC'S HYDROELECTRIC RESOURCES BY REGION AS OF JANUARY 1, 1988

In megawatts


58,231
Ungava Bay region
7,157
7,157
James Bay and Hudson Bay region
10,284
1,900
5,529
17,713
Côte-Nord region
7,497
1,056
7,043
15,596
Hannah Bay and Rupert Bay region
7,106
7,106
Saguenay region
2,534
737
3,271
Atlantic region
Outaouais region
2,089
132
2,221
Laurentides region
1,628
491
2,119
Montreal region
1,188
Southeastern region
16
16
Southeastern region
67
67

▇ Developed resources

▆ Resources under development

▨ Theoretically potential resources, including only power plants of 100 MW or more

☐ Total resources

ELECTRICITY IMPORTS AND EXPORTS

Québec is a front-line exporter of electricity due to Hydro-Québec's sales to other Canadian provinces and to the United States. In 1987, Québec exported a total of 28.8 billion kWh of electricity, 6.6% more than in 1986. Electricity exports to the United States rose sharply. Indeed, deliveries to American markets jumped 29.4% in one year, from 12.7 billion kWh in 1986 to 16.4 billion kWh in 1987. This marked increased in sales to the United States resulted from the beginning of operations, in October 1986, of the new interconnection with the New England Power Pool (NEPOOL) and the increase in the operating capacity of the interconnection with the New York Power Authority (NYPA).

In 1987, electricity exports represented 15.3% of the total electricity production available on the Québec market. Exports are divided almost evenly between the United States (New York and New England) and neighboring Canadian provinces (New Brunswick and Ontario). The State of New York has been Hydro-Québec's biggest buyer since 1979. Transmission to this state accounted for 33.8% of Hydro-Québec's total 1987 exports, compared to 23.2% to New England, 22.4% to New Brunswick and 20.5% to Ontario.

Since early 1987, the application of Hydro-Québec's export strategy has continued with the signing of three new sales contracts and agreements. In December 1987, Hydro-Québec entered into a contract with the Vermont Joint Owners for deliveries of up to 500 MW of guaranteed power and 68 billion kWh of guaranteed energy over a period of 25 years (1990-2015). A letter of intent with the NYPA was also signed in January 1988 for the sale, between 1995 and 2016, of two blocks of guaranteed power of 500 MW each for a possible 130 billion kWh of guaranteed energy. Moreover, in July 1988, Hydro-Québec and the Central Maine Power Company signed a contract under which Hydro-Québec will deliver a block of 300 MW of guaranteed power between 1992 and 2020.

Electricity sales to other markets have become an important element in Québec's energy balance of trade (see page 54). In 1987, revenues from Hydro-Québec exports rose to $713 million: $446 million from sales to the United States and $267 million from sales to other Canadian provinces. Overall, Hydro-Québec's export revenues rose by 9.9%, compared to 1986. This increase results from the substantial growth (18%) of revenues from sales to the United States; revenues from sales to other Canadian provinces remained virtually at last year's level.

In 1987, the government corporation's average export selling price was 2.48¢/kWh, which represents an increase of 2.9% over the preceding year. This increase results from the rise in the international price of crude oil. Rates for the majority of Hydro-Québec's exports are based on the production costs saved by the buyer. On the American market, electricity bought from Québec normally replaces that which would have been thermally generated by stations operating with heavy oil; in Ontario, the replaced fuel is generally coal, whose prices are also indirectly linked to those of oil. The average export price of electricity has increased sixfold over the past fifteen years. New England pays the highest average selling price for Québec electricity, while New Brunswick pays the lowest.

Québec imports only minimal amounts of electricity from the United States, Ontario and New Brunswick, although considerable supplies come in under a long-term agreement with Churchill Falls, Labrador (see page 56).

Table 6.6

QUÉBEC'S ELECTRICITY TRADE
1971-1987

In million kWh

	Purchases			Sales	
Year	From the U.S.	From other provinces[1]	From Churchill Falls	To the U.S.	To other provinces
1971	2	446	184	67	6 065
1972	3	278	6,324	83	9,174
1973	3	188	13,814	270	12,146
1974	5	309	22,152	881	14,264
1975	9	346	29,524	918	15,137
1976	29	393	32,025	525	15,377
1977	23	422	33,275	578	14,461
1978	21	806	36,947	1,418	12,207
1979	5	273	35,221	7,663	8,977
1980	6	120	37,759	8,107	9,442
1981	7	118	35,881	8,314	10,211
1982	7	121	35,716	8,530	9,383
1983	9	93	31,188	10,228	9,349
1984	8	91	35,989	11,250	11,706
1985	3	133	31,806	9,581	14,627
1986	35	61 rd	30,666	12,674	14,387 rd
1987		61	30,366	16,401	12,433

rd: revised data

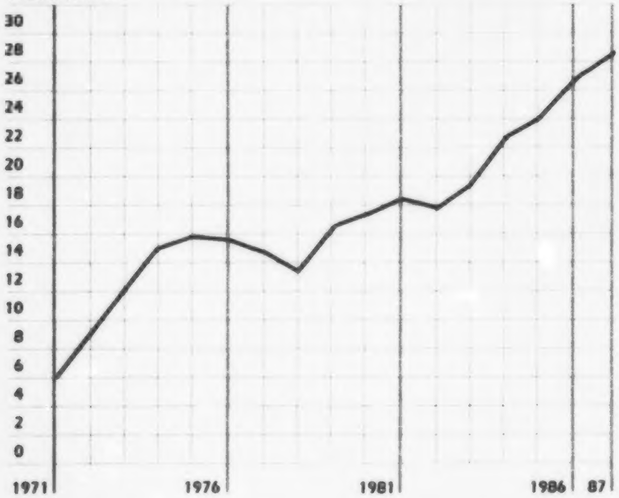
1. Excludes purchases from Churchill Falls.

Source: Statistics Canada, catalogues 57-001, 57-003 and 57-202.

Graph 6.6

QUÉBEC'S ELECTRICITY EXPORTS[1]

In billion kWh



1. Including sales of electricity to the United States and to other provinces of Canada.

Table 6.7

HYDRO-QUÉBEC'S ELECTRICITY EXPORTS[1], BY MARKET 1971-1987

In million kWh

Year	New Brunswick	Ontario	State of New York	New England	Total
1971	165	5,176		67	5,408
1972	1,054	7,859		85	8,998
1973	2,489	9,278	204	66	12,037
1974	3,473	10,515	797	82	14,867
1975	3,771	11,122	833	80	15,806
1976	3,714	11,378	433	69	15,594
1977	3,723	10,415	476	83	14,697
1978	3,546	8,189	1,293	110	13,138
1979	3,570	5,164	7,517	146	16,397
1980	3,674	5,668	7,796	306	17,444
1981	3,721	6,435	7,968	349	18,473
1982	3,614	5,731	8,336	199	17,880
1983	3,986	5,326	10,028	197	19,537
1984	4,341	7,302	11,000	239	22,882
1985	5,974	8,635	8,971	613	24,193
1986	7,053	7,258	9,761	2,861	26,933
1987	6,446	5,906	9,732	6,685	28,769

1. Invoiced deliveries only.
Source: Hydro-Québec.

Table 6.8

EXPORT PRICES FOR ELECTRICITY — HYDRO-QUÉBEC'S AVERAGE SELLING PRICE, BY MARKET 1971-1987

In cents per kWh

Year	New Brunswick	Ontario	State of New York	New England	Overall market
1971	0.73	0.40		0.60	0.42
1972	0.45	0.29		0.59	0.31
1973	0.39	0.38	0.69	0.91	0.39
1974	0.49	0.47	1.29	0.98	0.52
1975	0.57	0.49	1.81	1.38	0.58
1976	0.61	0.49	2.06	1.59	0.57
1977	0.95	0.56	1.42	1.81	0.70
1978	1.19	0.86	1.11	1.91	0.98
1979	1.60	1.04	1.42	2.26	1.35
1980	1.79	1.24	1.99	2.73	1.72
1981	2.42	1.38	2.31	3.44	2.03
1982	2.63	1.50	3.42	3.97	2.65
1983	2.77	1.45	3.31	3.72	2.70
1984	3.22	1.62	3.44	3.82	2.82
1985	3.06	1.83	3.41	4.32	2.78
1986	1.92	1.88	2.94	3.16	2.41
1987	2.01	2.30	2.45	3.09	2.48

Source: Hydro-Québec.

Graph 6.7

HYDRO-QUÉBEC'S EXPORT REVENUES
1971-1987

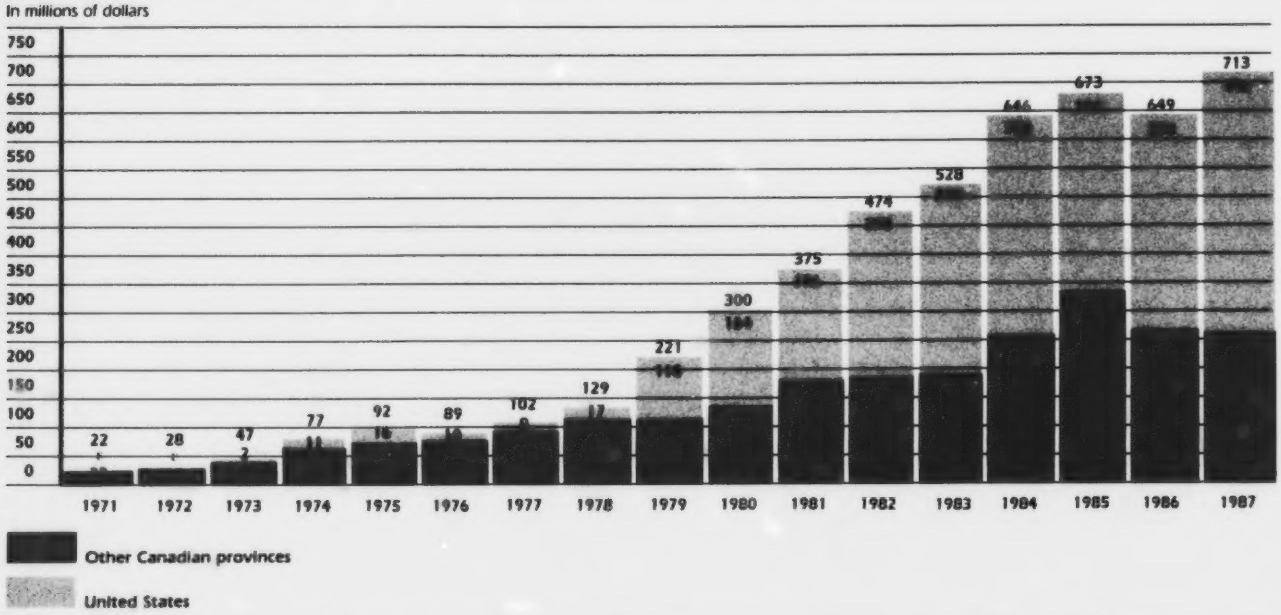


Table 6.9

EXPORT CONTRACTS AND AGREEMENTS SIGNED WITH AMERICAN STATES

Company	Date of signing	Duration	Quantity	
			Power	Energy
New York				
New York Power Authority				
• Diversity power	March 1974	1977-1988 (April to October)	800 MW	3 TWh per year
• Interconnection agreement	May 1976	1978-1998		
• Surplus energy	March 1982	1984-1997	None	111 TWh
• Firm power and energy	January 1988	1995-2015	500 MW	65 TWh
		1996-2016	500 MW	65 TWh
Niagara Mohawk Power Corporation				
• Interconnection agreement	February 1982	1982 until abrogated		
New England				
New England Power Pool				
• Surplus energy	March 1983	1986-1997	None	33 TWh
• Interconnection agreement	March 1983	1986 until abrogated		
• Energy storage agreement	March 1983	1986-2004		
• Firm energy	October 1985	1990-2000	None	70 TWh
• Short-term firm power and energy	December 1987	December 1987 to March 1988	500 MW	
Vermont Department of Public Service				
• Firm power and energy	July 1984	1985-1996	150 MW	Maximum of 1,318 GWh per year
• Interconnection agreement	July 1984	1985-1996		
Citizens Utilities Company				
• Firm energy and diversity power	March 1985	1986-1990	20 MW (minimum) in 1986 up to 56 MW (maximum) in 1990	65.7 GWh (minimum) in 1986 up to 239 GWh (maximum) in 1990
• Assured secondary energy	March 1985	1986-1990		
• Firm power and energy	December 1986	1986-1988 (December to March)	30 to 32 MW	168 GWh to 178 GWh
• Interconnection agreement	November 1987	1987 until abrogated		

Table 6.9 (continued)

EXPORT CONTRACTS AND AGREEMENTS SIGNED WITH AMERICAN STATES

Company	Date of signing	Duration	Quantity	
			Power	Energy
Vermont Marble Company				
• Firm power and energy	July 1986	1987-1991	0.75 MW	36.8 GWh per year
Vermont Joint Owners				
• Firm power and energy	February 1987	March 1987 to November 1990	50 MW	438 GWh per year, except for the first part of the contract
• Interconnection agreement	February 1987	1987 until abrogated		
• Firm power and energy	December 1987	1990-1995 1995-2015	50 MW 200 MW, with possibility of reaching 500 MW	Possibility of reaching 67.5 TWh
Boston Edison Company				
• Diversity power	March 1988	May 1988 to November 1988	82 MW	421 GWh
Central Maine Power Company				
• Firm power and energy	July 1988	1992-2020	300 MW, with possibility of reaching 900 MW	Possibility of reaching 122 TWh
Montaup Electric Company				
• Diversity Power	April 1988	1988-1989 (May to November)	26 MW	228 GWh

Source: Direction des analyses techniques et économiques of the ministère de l'Énergie et des Ressources du Québec.

TRANSMISSION

The nature of Québec's electricity production — it is generated by hydroelectric power plants often located far from consumption centers — has led to the development of an extensive transmission network. The transmission lines of Hydro-Québec alone stretch across more than 33,635 km, which makes this network one of the largest in North America. In order to transmit electricity over long distances, Hydro-Québec has developed technology, a logistics system and an organizational structure which now place it among the international experts in this field. Currently, Hydro-Québec is capable of providing electricity to virtually all the populated areas in Québec, by way of an integrated network which distributes all the available power to every region of the province. It was in Québec that the first 735 kV lines were used, and more than one third of the network is composed of these lines.

Since 1985, modifications in the area of electricity transmission have been aimed primarily at optimizing and consolidating the network. Hydro-Québec's investments in its transmission network reached nearly $500 million in 1987. Part of this sum was allocated to continue the construction project of the 450 kV direct current Radisson-Nicolet-des-Cantons transmission line. This line will serve to meet Québec's electricity needs and to export energy to New England.

The signing of major contracts for the exportation of electricity to other Canadian provinces and to the United States has led to the establishment of an interconnection network. As of December 31, 1987, the total transmission capacity of this network was 6,315 MW. A new interconnection was brought into service by Hydro-Québec in October 1986. A ±450-kV continuous supply line now links up the Cantons station in Québec with the Comerford station in New Hampshire. This interconnection with NEPOOL currently makes it possible to relay 690 MW into New Hampshire. After 1990, the capacity of the interconnection will be upped to 2,000 MW.

Table 6.10

INTERCONNECTIONS AS OF DECEMBER 31, 1987

Interconnected network	Number of lines	Operation voltage	Transmission capacity
Ontario	6	120 kV and 230 kV	6,315 MW, of which 5,375 MW can be delivered simultaneously
New Brunswick	3	230 kV, 315 kV and 345 kV	
New York State	2	120 kV and 765 kV	
Vermont	3	120 kV and ±450 kV	

Table 6.11

INVESTMENTS IN QUÉBEC'S ELECTRICITY INDUSTRY 1971-1987

In millions of current dollars

Year	Hydro-Québec					Private producers	Total[3]
	Production[1]	Transmission[1]	Distribution[1]	Other[2]	Total		
1971	118.9	184.6	52.3	32.8	388.6	na	388.6
1972	187.9	142.5	60.2	33.2	423.8	na	423.8
1973	316.0	125.2	78.4	31.1	550.7	na	550.7
1974	411.6	66.2	96.3	41.7	615.8	na	615.8
1975	817.1	135.1	143.2	46.4	1,141.8	na	1,141.8
1976	959.1	154.0	119.5	35.6	1,268.2	1.0	1,269.2
1977	1,441.8	284.4	180.0	49.7	1,955.9	2.6	1,958.5
1978	1,751.8	545.1	209.6	82.2	2,588.7	3.8	2,592.5
1979	1,825.0	687.8	205.9	99.3	2,818.0	7.4	2,825.4
1980	1,656.6	594.7	254.0	86.2	2,591.5	2.4	2,593.9
1981	1,664.8	590.4	311.8	101.0	2,668.0	3.6	2,671.6
1982	1,359.5	694.6	312.3	177.1	2,543.5	6.6	2,550.1
1983	1,163.0	568.2	283.5	156.5	2,171.2	5.5	2,176.7
1984	464.2	596.0	400.0	130.2	1,590.4	13.9	1,604.3
1985	327.8	436.4	518.4	244.7	1,527.3	14.4	1,541.7
1986	371.7	356.9	506.9	234.5	1,470.0	9.5	1,479.5
1987	339.8	499.4	518.0	224.1	1,581.3	9.9	1,591.2

na: not available

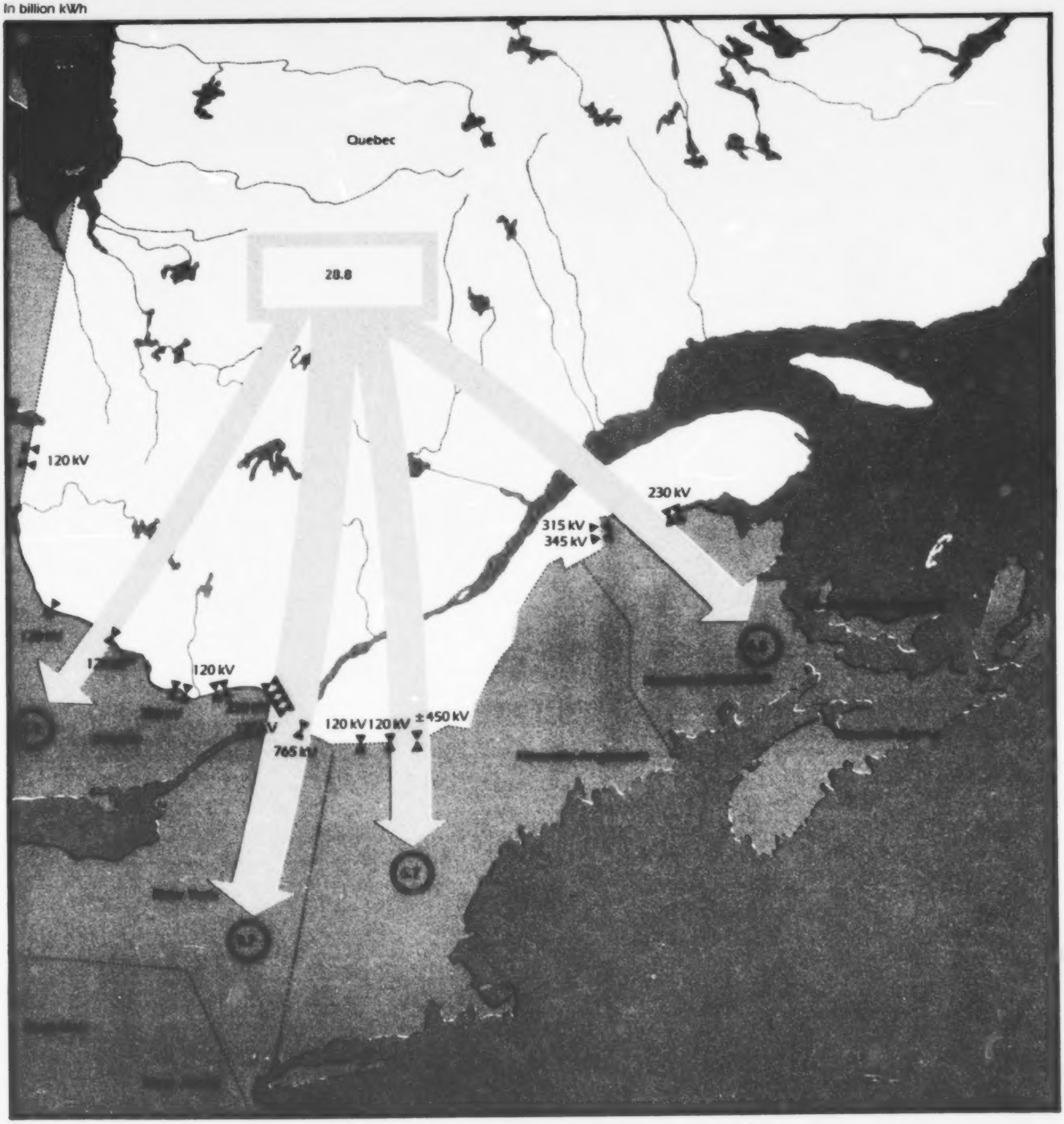
1. Excludes accounting write-offs and includes interests on construction.
2. Includes all administrative buildings, and construction, operation and research equipment; excludes subsidies for commercial programs.
3. Total investments for 1971-1975 do not include those made by private producers.

Sources: Hydro-Québec, and annual reports filed by private producers with the Régie de l'électricité et du gaz.

Graph 6.8

ELECTRICITY DELIVERED OUTSIDE QUÉBEC[1] 1987

In billion kWh


Quebec
28.8
120 kV
120 kV
120 kV
765 kV
120 kV
120 kV
±450 kV
315 kV
345 kV
230 kV

Légend

▶◀ Interconnection

1. Invoiced deliveries only.

DISTRIBUTION

Hydro-Québec's network covers virtually all of Québec's populated territory and provides very good conditions for the distribution of electricity. Of the networks supplied by Hydro-Québec, not all are connected to its main network; these include villages in the Basse-Côte-Nord region and on the Îles-de-la-Madeleine, as well as municipalities in Nouveau-Québec.

As of December 31, 1987, distribution lines installed in the province by Hydro-Québec measured a total 90,395 km.

Hydro-Québec's objective of enhancing the reliability of its distribution network has led the company to substantially increase its investments in this area over the past few years. During the past three years, in fact, the distribution sector has been Hydro-Québec's major investment area. At $518 million, the investment level in 1987 was comparable to that of the two preceding years. These investments in the electricity distribution network represented 32.8% of Hydro-Québec's total 1987 investments.

Table 6.12

HYDRO-QUÉBEC'S DISTRIBUTION NETWORK
1971-1987

Year	Length of lines[1] (kilometers)	Investments (million current dollars)
1971	69,387	52.3
1972	70,843	60.2
1973	72,315	78.4
1974	73,779	96.3
1975	75,490	143.2
1976	76,880	119.5
1977	78,900	180.0
1978	80,365	209.6
1979	83,217	205.9
1980	83,597	254.0
1981	86,291	311.8
1982	87,561	312.3
1983	89,252	283.5
1984	87,413	400.0
1985	89,190	518.4
1986	88,617	506.9
1987	90,395	518.0

[1] As of December 31 each year.
Source: Hydro-Québec.

DOMESTIC CONSUMPTION OF ELECTRICITY

1987 saw a relatively sharp increase in Québec's electricity consumption. Total consumption reached 146 billion kWh (12.6 billion toe), a 4.6% increase over 1986. This increase was particularly high in the commercial sector (7.2%) and the industrial sector (6.4%), while it was virtually nil in the residential sector (0.1%), and actually decreased (– 1.8%) in the transportation sector. The relatively rapid rise in commercial consumption was partially due to the success of the subsidy program implemented by Hydro-Québec to encourage the installation of dual-energy systems in the commercial and institutional sectors. The increase in consumption observed in the industrial sector resulted from the fine performance of a number of industries, particularly smelting and refining, pulp and paper and the chemical industry. Thanks to this sharp increase in consumption, the share of electricity in overall energy consumption climbed by more than one point, from 40.1% in 1986 to 41.7% in 1987.

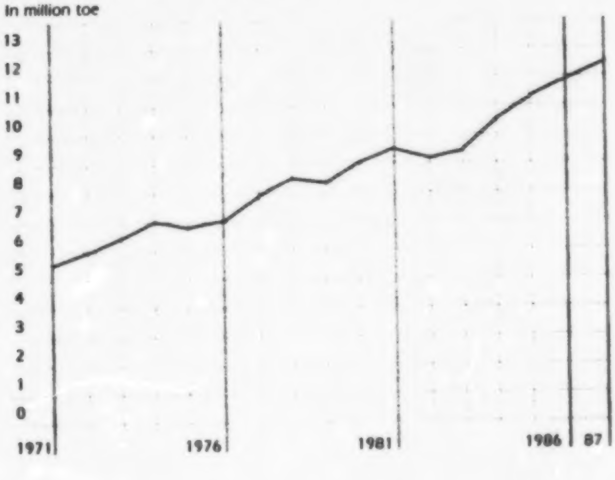
Analysis of changes in the share of electricity in total energy consumption since the early seventies reveals that, until 1977, it remained virtually unchanged, at around 20%. At that time, electricity sales began to surge and have not abated since. The absolute value of electricity consumption in Québec has increased by 76.7% since 1976, although the overall demand for energy decreased by 7.9% during the same period. Except for the transportation sector, where the market is virtually tied to oil, the share of electricity is now 56.9% of the total energy demand, compared to 30.9% in 1976. Electricity is by far the most widely used energy form in the residential, commercial and industrial sectors.

One of the most instrumental factors in this development has been the very rapid increase in home electricity consumption, a result of the growing popularity of electric heating. Since 1971, an estimated 1,100,000 homes (old and new) have adopted electric heating. In 1987 alone, 111,200 homes were newly equipped with electric heating. More than three fifths (71,200) were new homes, among which electric heating sales reached 96%. The remaining 40,000 homes were converting to electricity from another heating system.

Analysis of electricity consumption in the industrial sector (mining and manufacturing) shows that, between 1971 and 1984, the combined consumption of the ore processing industry and industries manufacturing paper and related products accounted for about three quarters of the total electricity consumption in this sector. The ore processing industry alone consumed almost two fifths of the electricity that went to the industrial sector.

Graph 6.9

ELECTRICITY CONSUMPTION



Graph 6.10

SHARE OF EACH SECTOR IN ELECTRICITY CONSUMPTION 1987

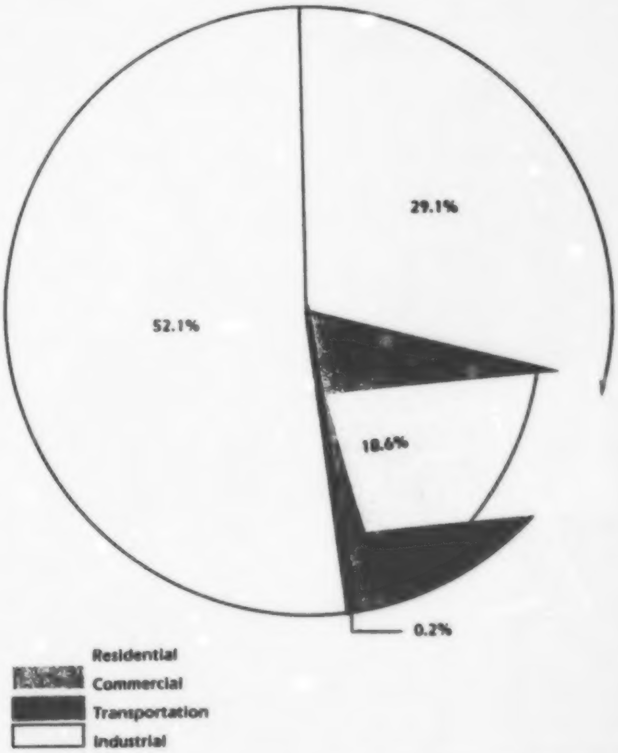


Table 6.13

ENERGY CONSUMPTION BY SECTOR[1]
1971-1987

Year	Residential sector		Commercial sector		Transportation sector[2]		Industrial sector	
	thousand kWh	%	thousand kWh	%	thousand kWh	%	thousand kWh	%
1971	13,267,420	20.55	14,463,385	22.41			36,824,230	57.04
1972	14,529,536	20.73	18,003,283	25.68			37,571,488	53.59
1973	16,080,504	21.38	19,299,085	25.67			39,811,692	52.95
1974	18,222,037	21.95	19,516,816	23.51			45,275,483	54.54
1975	19,829,431	24.81	17,429,274	21.80			42,675,385	53.39
1976	22,883,950	27.70	19,505,149	23.61			40,223,185	48.69
1977	25,710,977	27.66	23,201,075	24.96			44,041,487	47.38
1978	27,874,100	27.93	19,319,800	19.36	238,300	0.24	52,352,600	52.47
1979	28,949,100	29.47	19,739,500	20.10	251,900	0.26	49,285,000	50.17
1980	31,052,300	29.26	20,392,200	19.22	278,100	0.26	54,383,700	51.26
1981	33,309,200	29.97	20,993,700	18.89	272,700	0.25	56,553,200	50.89
1982	33,690,500	31.09	21,239,100	19.60	284,600	0.26	53,166,300	49.05
1983	33,918,600	30.58	21,493,700	19.38	311,600	0.28	55,203,100	49.76
1984	37,597,200	30.39	21,606,500	17.47	303,300	0.24	64,202,200	51.90
1985	40,184,800	30.26	22,269,100	16.77	322,900	0.24	70,017,500	52.73
1986	42,379,600	30.37	25,435,200	18.22	322,200	0.23	71,431,300	51.18
1987	42,430,300	29.06	27,214,400	18.64	316,500	0.22	76,025,300	52.08

1. Excluding other uses.
2. Up to 1978, Statistics Canada made no mention of electricity consumption in this sector.

Table 6.14

DEVELOPMENT OF ELECTRIC HEATING IN THE RESIDENTIAL SECTOR
1971-1987

Year	Old homes	New homes		
	Conversion to electricity (number of conversions)	Homes heated with electricity (number of homes)	Penetration rate (%)	Total number of homes with new electric heating (number of homes)
1971	1,153	22,441	43.3	23,594
1972	1,544	29,695	48.4	31,239
1973	2,305	33,641	56.5	35,946
1974	7,000	29,844	57.8	36,844
1975	9,987	32,408	59.2	42,395
1976	12,023	44,200	64.3	56,223
1977	17,555	43,185	75.0	60,740
1978	16,967	33,627	77.0	50,594
1979	28,000	34,218	82.0	62,218
1980	35,490	24,516	84.0	60,006
1981	47,106	27,273	92.0	74,379
1982	39,922	21,143	90.0	61,065
1983	51,000	36,286	90.0	87,286
1984	52,000	37,712	90.0	89,712
1985	44,600	43,708	91.0	88,308
1986	42,700	56,124	93.0	98,824
1987	40,000	71,212	96.0	111,212

Source: Hydro-Québec.

Table 6.15

CONSUMPTION OF ELECTRICITY BY CERTAIN INDUSTRIES
1971-1984

	Mining		Paper and related products[1]		Ore processing		Non-metallic mineral products		Chemical industry		Mining and manufacturing industries total
Year	million kWh	%	million kWh	%	million kWh	%	million kWh	%	million kWh	%	million kWh
1971	2,371	5.8	11,001	26.7	19,848	48.2	1,021	2.5	2,369	5.8	41,145
1972	2,211	5.3	12,176	29.0	19,354	46.2	1,062	2.5	2,312	5.5	41,915
1973	2,590	5.8	12,420	28.0	20,194	45.5	1,279	2.9	2,590	5.8	44,339
1974	2,897	6.1	13,288	27.8	22,630	47.3	1,267	2.6	2,647	5.5	47,872
1975	2,264	5.2	12,296	28.4	19,498	45.0	1,179	2.7	2,426	5.6	43,331
1976	3,211	7.9	13,868	34.1	14,095	34.7	1,259	3.1	2,796	6.9	40,678
1977	3,323	7.0	13,707	28.9	20,921	44.1	1,231	2.6	2,654	5.6	47,416
1978	3,136	6.1	14,713	28.8	22,727	44.5	1,376	2.7	2,886	5.6	51,112
1979	3,912	8.0	14,850	30.3	18,978	38.8	1,455	3.0	3,037	6.2	48,973
1980	3,258	5.9	15,248	27.8	24,484	44.7	cd		3,451	6.3	54,784
1981	3,306	5.9	16,515	29.3	24,519	43.5	1,281	2.3	cd		56,358
1982	2,654	5.1	15,439	29.5	22,905	43.8	1,054	2.0	3,591	6.9	52,324
1983	2,627	4.8	17,324	31.5	23,633	43.0	1,122	2.0	3,498	6.4	55,021
1984	2,859	4.7	22,057	36.2	23,716	38.9	cd		3,732	6.1	60,968

cd: confidential data.

[1] Includes an estimate of producer consumption of electricity.

N.B.: For statistical reasons, it is not possible to compare the data in this table with those in Table 6.13.

Sources: Statistics Canada, catalogues 57-208 and 57-506; and estimated by the Direction des études et statistiques of the ministère de l'Énergie et des Ressources du Québec.

7. OIL

EXPLORATION

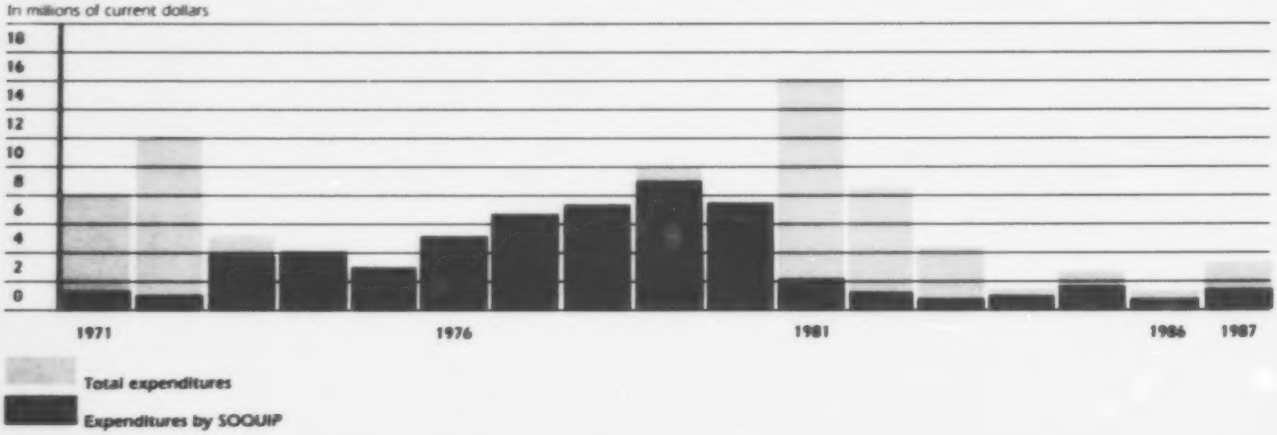
In 1987, exploration expenditures in Québec amounted to $3.3 million, compared to $1.4 million in 1986. Despite this increase, exploration activities are still considered marginal. Approximately one third of these investments were made by the Société québécoise d'initiatives pétrolières (SOQUIP). It should also be noted that the greater part of exploration expenditures, or $2.5 million, were earmarked for research and development of underground storage tanks intended for natural gas and natural gas liquids.

Exploration activities continued on the Gaspé peninsula to determine the feasibility of recovering the oil found there. SOQUIP concentrated its exploration efforts in the areas of Pointe-du-Lac and Montréal-Est, essentially to develop underground storage tanks. New exploration activities were undertaken on Anticosti Island in 1987.

Exploration carried out in 1987 in the Yamachiche and Louiseville regions led to the discovery of potential natural gas deposits. Following seismic studies conducted in 1986-1987, drilling operations have been undertaken in the Lac Saint-Pierre region in search of fossil fuel deposits.

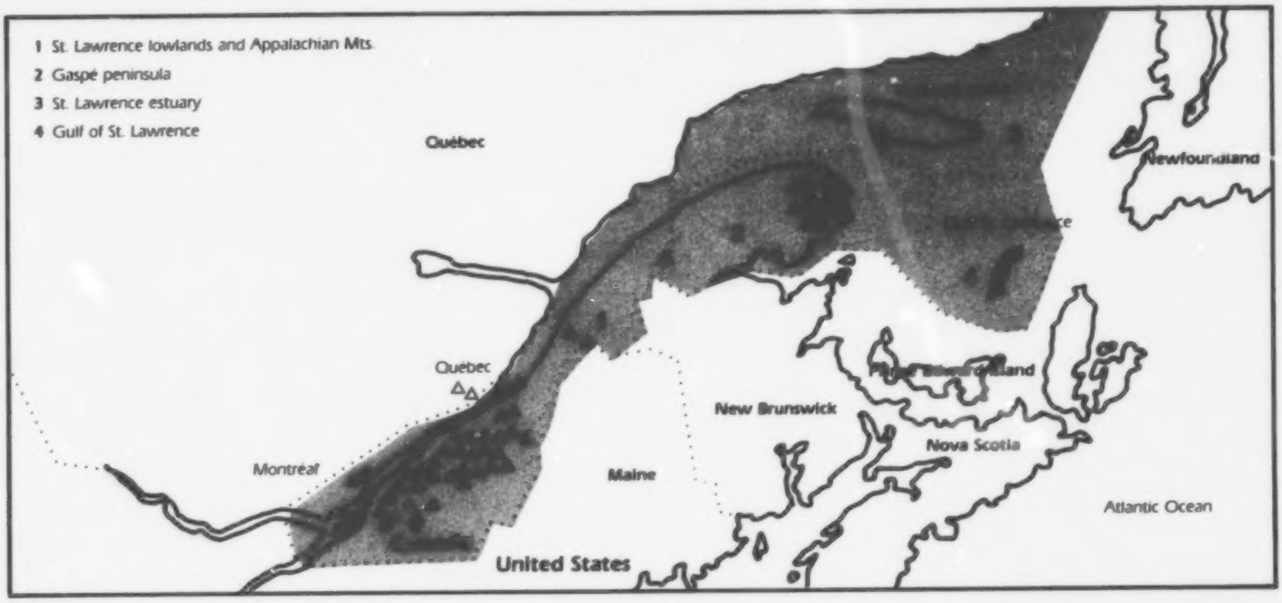
Graph 7.1

EXPENDITURES FOR FOSSIL FUEL EXPLORATION IN QUÉBEC



Graph 7.2

QUÉBEC'S SEDIMENTARY ZONE, WITH POTENTIAL FOSSIL FUEL RESERVES AND WELLS DRILLED BETWEEN 1974-1987[1]


1 St. Lawrence lowlands and Appalachian Mts.
2 Gaspé peninsula
3 St. Lawrence estuary
4 Gulf of St. Lawrence
Québec
Newfoundland
Québec
Montreal
New Brunswick
Prince Edward Island
Nova Scotia
Maine
United States
Atlantic Ocean

▲ Wells drilled by SOQUIP △ Wells drilled by SOQUIP with other companies ◆ Wells drilled by other companies

1. Including wells 300 metres deep and deeper.

CRUDE OIL IMPORTS

The sharp decline in crude oil imports, first felt in 1973, was interrupted in 1987. After plunging 55.7% between 1973 and 1986, crude oil imports edged up 0.4% in one year.

Producing North Sea countries — the United Kingdom and Norway — became Québec's largest source of crude oil in 1987, providing 47.4% of its imports, compared to 35.1% in 1986. There was a renewed drop in the quantity of oil being brought in from western Canada in 1987, providing Québec with 32.9% of its imports compared to 40.2% in 1986. The rest of America, especially Mexico and Venezuela, supplied 11.8% of Québec's total imports in 1987. Purchases from the Middle East and Africa represented only 5.3% of Québec's supplies in 1987, compared to 8.9% in 1986.

Table 7.1

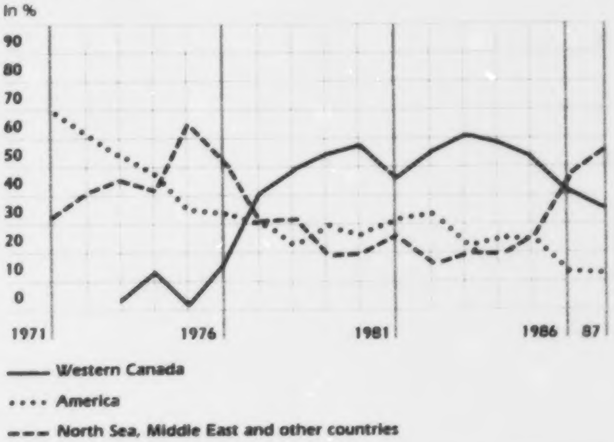
SOURCES OF QUÉBEC'S CRUDE OIL IMPORTS
1971-1987

	1971		1976		1981		1984		1985		1986		1987	
Origin	**thousand barrels**	**%**	**thousand barrels**	**%**	**thousand barrels**	**%**	**thousand barrels**	**%**	**thousand barrels**	**%**	**thousand barrels**	**%**	**thousand barrels**	**%**
CANADA														
Western Canada			30,394	15.3	77,237	44.7	65,209	57.2	52,226	52.2	36,722	40.2	30,183	32.9
Eastern Canada													23	r
CANADA TOTAL			**30,394**	**15.3**	**77,237**	**44.7**	**65,209**	**57.2**	**52,226**	**52.2**	**36,722**	**40.2**	**30,206**	**32.9**
INTERNATIONAL MARKET														
Africa														
Algeria					6,622	3.8	3,774	3.3	2,238	2.2				
Libia	443	0.3	6,686	3.4	1,451	0.8	514	0.4						
Nigeria	20,650	12.1	9,784	4.9	1,364	0.8	3,482	3.1	2,952	3.0	2,797	3.1	3,788	4.1
Africa Total	*21,093*	*12.4*	*16,470*	*8.3*	*9,437*	*5.4*	*7,770*	*6.8*	*5,190*	*5.2*	*2,797*	*3.1*	*3,788*	*4.1*
America														
United States					7,665	4.4	589	0.5	1,393	1.4	395	0.4		
Mexico					14,113	8.2	7,920	7.0	7,009	7.0	5,582	6.1	6,365	7.0
Colombia	7,367	4.3												
Venezuela	110,991	65.1	65,982	33.2	30,725	17.8	19,046	16.7	14,927	14.9	5,748	6.3	4,418	4.8
America Total	*118,358*	*69.4*	*65,982*	*33.2*	*52,503*	*30.4*	*27,555*	*24.2*	*23,329*	*23.3*	*11,725*	*12.8*	*10,783*	*11.8*
Middle East														
Saudi Arabia	4,041	2.4	9,481	4.8	16,144	9.4							1,056	1.2
United Arab Emirates	3,479	2.0	21,000	10.6	1,061	0.6								
Irak	9,140	5.4	10,626	5.3	194	0.1								
Iran	14,409	8.4	28,410	14.3			3,091	2.7	748	0.8	5,339	5.8		
Kuweit			859	0.4	3,981	2.3								
Middle East Total	*31,069*	*18.2*	*70,376*	*35.4*	*21,380*	*12.4*	*3,091*	*2.7*	*748*	*0.8*	*5,339*	*5.8*	*1,056*	*1.2*
Other Countries														
United Kingdom			na	na	na	na	na	na	16,183	16.1	30,855	33.8	42,322	46.2
Norway			na	na	na	na	na	na	373	0.4	1,178	1.3	1,145	1.2
Others			15,578	7.8	12,190	7.1	10,359	9.1	2,001	2.0	2,697	3.0	2,397	2.6
Other Countries Total			*15,578*	*7.8*	*12,190*	*7.1*	*10,359*	*9.1*	*18,557*	*18.5*	*34,730*	*38.1*	*45,864*	*50.0*
INTERNATIONAL MARKET TOTAL	**170,520**	**100.0**	**168,406**	**84.7**	**95,510**	**55.3**	**48,775**	**42.8**	**47,824**	**47.8**	**54,591**	**59.8**	**61,491**	**67.1**
TOTAL IMPORTS	**170,520**	**100.0**	**198,800**	**100.0**	**172,747**	**100.0**	**113,984**	**100.0**	**100,050**	**100.0**	**91,313**	**100.0**	**91,697**	**100.0**

na: not available
Source: Statistics Canada, catalogue 45-004

Graph 7.3

SOURCES OF QUÉBEC'S CRUDE OIL IMPORTS



TRANSPORTATION AND STORAGE

Québec's crude oil supplies are delivered by ship or by pipeline. Crude oil imported from the world market arrives through Portland harbour (Maine) and the Portland-Montréal pipeline, or by ship along the St. Lawrence. Crude oil coming in from the Canadian West has been delivered through the Sarnia-Montréal pipeline since 1976. In 1987, slightly less than two thirds (64.2%) of the crude oil deliveries to Québec arrived by pipeline, while the remaining third (35.8%) came in by ship. In relation to 1986, pipeline deliveries continued to decline in 1987 because of the reduction in imports from western Canada.

To ensure steady supplies of crude oil, the oil companies have tanks where they store the necessary quantities. Substantial storage capacities must also be maintained for refined products, because of additional constraints arising from the petroleum product distribution market.

As of December 31, 1986, the storage capacity for crude oil and petroleum products was approximately 50 million barrels, the same as in 1985. About 14% of this storage capacity was for crude oil (compared to 20% in 1985), concentrated close to the refineries in the Montréal and Québec City areas. Almost three quarters of petroleum product storage (86% of the total capacity, compared to 80% in 1985) was ensured through marine terminals, although storage capacity also included inland storage sites and the tanks of gasoline retailers.

Variations noted in the components of storage capacity in 1986 were almost entirely attributable to the closing of the Gulf refinery in that year — with the subsequent transfer of Gulf's storage capacity to the refined product distribution network. Between 1980 and 1986, Québec's storage capacity for crude oil and petroleum products was reduced by approximately 30%, a reflection of the considerable drop in petroleum product consumption.

Graph 7.4

QUÉBEC'S CRUDE OIL SUPPLIES 1987

In million barrels

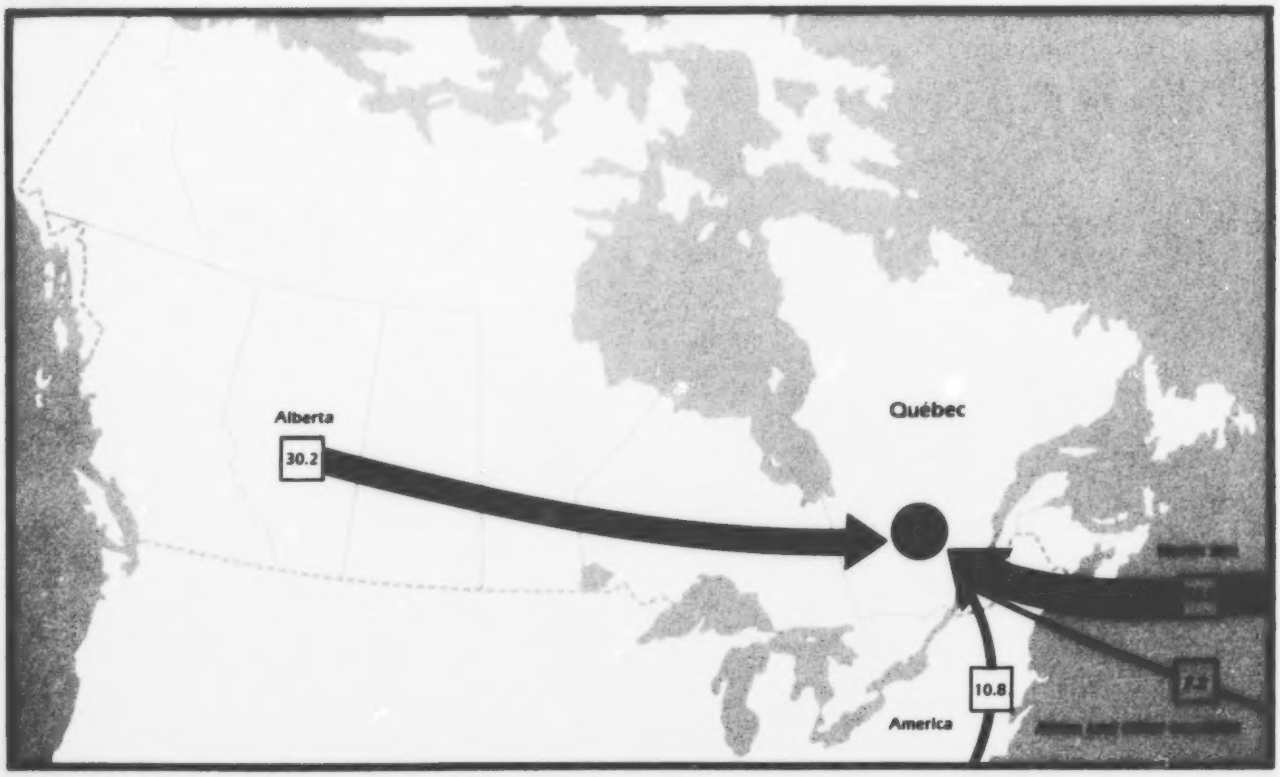


Table 7.2

QUÉBEC'S STORAGE CAPACITY[1] FOR CRUDE OIL AND ENERGY-RELATED PETROLEUM PRODUCTS 1980-1986

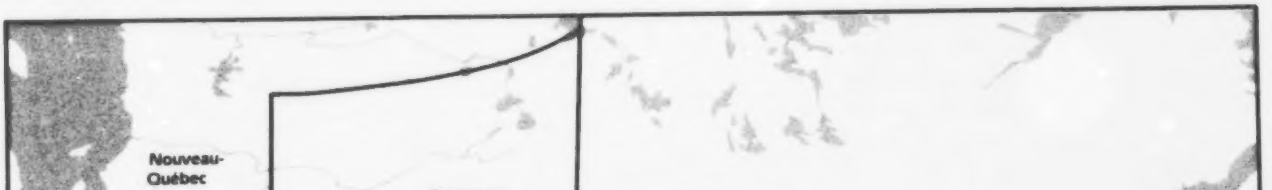
	1980[2]	1984[2]	1985[2]	1986[2 3]	%
	thousand barrels	thousand barrels	thousand barrels	thousand barrels	variation 1986/1985
Crude oil					
Refineries	13,030	8,641	8,641	7,136	– 17.4
Petroleum products					
Refineries	26,564	12,406	12,406	10,448	– 15.8
Petroleum product wholesalers	28,826	26,617	26,624	30,001	+ 12.7
Gasoline retailers	2,415	2,500	2,522	2,506	– 0.6
Total	**70,835**	**50,164**	**50,193**	**50,091**	**– 0.2**

1. Includes tanks for storing gasoline, middle distillates and heavy fuel oils.
2. As of December 31 of each year.
3. The storage capacity of the Gulf refinery which closed in 1986 has been transferred to the section "Petroleum product wholesalers".

Graph 7.5

DISTRIBUTION OF STORAGE FOR CRUDE OIL AND ENERGY-RELATED PETROLEUM PRODUCTS,[1] BY ADMINISTRATIVE REGION 1986

In million barrels


Nouveau-Québec
0.4
Saguenay – Lac-Saint-Jean
2.4
Côte-Nord
2.6
Abitibi – Témiscamingue
0.3
Bas-Saint-Laurent – Gaspésie
2.1
UNDLAND
Outaouais
0.2
Trois-Rivières
1.7
Québec
13.5
Montréal
26.7
NEW BRUNSWICK
ONTARIO
Estrie
0.2
UNITED STATES
NOVA SCOTIA

1. Includes tanks used for storing crude oil, gasoline, middle distillates and heavy fuel oil.

REFINING

As of December 31, 1987, three refineries were operating in Québec: the Petro-Canada and Shell refineries in the Montréal area, and the Ultramar refinery in Saint-Romuald, just south of Québec City. The production capacity of Québec's refineries was 310,600 barrels per day in 1987, the same level that was recorded on December 31, 1986. Québec's share in Canada's total refining capacity fell slightly, from 15.9% in 1986 to 15.1% in 1987. This decline is due to the reopening of the Come-by-Chance refinery, with a capacity of 100,000 barrels per day.

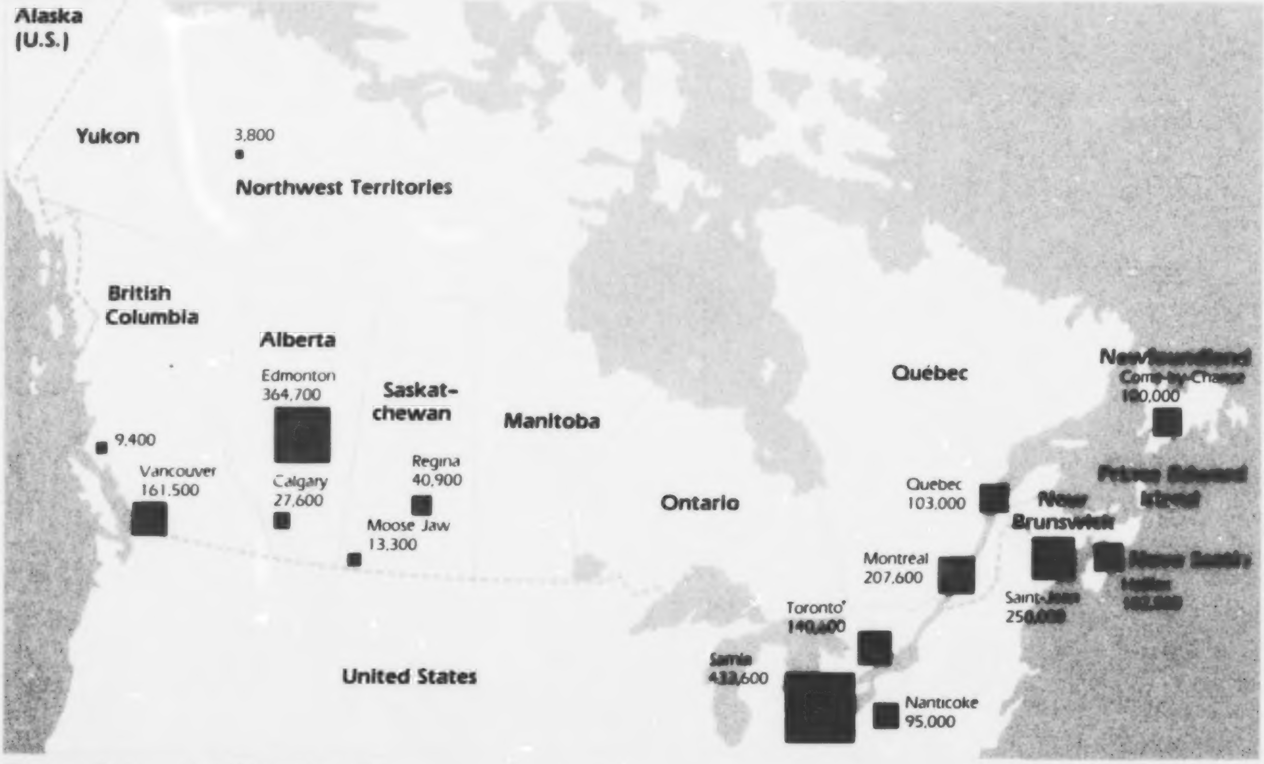
The rationalization efforts of 1986, with the closing of the Gulf refinery, resulted in the continued improvement of the utilization rate of Québec refineries. This rate was 89.1% in 1987, compared to 84.5% in 1986. Rates in Ontario, the Atlantic provinces and Canada as a whole were significantly lower, reaching 74.5%, 53.6% and 75.7%, respectively.

Canada's refining capacity represented 2.8% of the world capacity in 1987, compared to 2.7% in1986. In 1987, for the first time since 1981, the total world refining capacity ceased to decline, reaching 74.1 million barrels per day, or 0.5% more than in 1986. At the same time, the shift in the refining capacity of certain oil producing and exporting countries, especially in the Middle East, increased in 1987. In one year, Middle East countries increased their refining capacity by 270,000 barrels per day. This shift seems to have come about especially to the detriment of western Europe, which recorded a drop of 300,000 barrels per day in its refining capacity. In all, in 1987, almost one quarter of the world's refining capacity was located in North America (24.0%), as opposed to 24.1% in countries with a planned economy, 18.9% in western Europe and 13.9% in the Far East.

Graph 7.6

REFINING CENTERS IN CANADA AS OF DECEMBER 31, 1987

In barrels per day


Alaska (U.S.)
Yukon
3,800
Northwest Territories
British Columbia
Alberta
Edmonton 364,700
Saskat-chewan
Manitoba
9,400
Vancouver 161,500
Calgary 27,600
Regina 40,900
Moose Jaw 13,300
Ontario
Québec
Newfoundland
Come-by-Chance 100,000
Quebec 103,000
Prince Edward Island
New Brunswick
Nova Scotia
Halifax
Montreal 207,600
Saint-Jean 250,000
Toronto' 140,600
Sarnia 432,600
Nanticoke 95,000
United States

■ Centre refining more than 2,000 barrels per day

Sources: Canadian Petroleum Association and the ministère de l'Energie et des Ressources du Quebec

Table 7.3

MAIN CHARACTERISTICS OF QUÉBEC REFINERIES AS OF DECEMBER 31, 1987

Refinery	Crude oil storage capacity[1]	Processing capacity[2]	Vacuum distillation units[2]	Cracking units: Process	Cracking units: Quantity[2]	Catalytic reforming units: Process	Catalytic reforming units: Quantity[2]
Petro-Canada, Pointe-aux-Trembles, Montréal	2,001,000	87,500	40,900	Catalytic Hydrocracking Viscoreduction Canmet	17,200 14,400 12,800 5,000	Catalytic	31,100
Shell Canada Ltd., Montreal-Est	2,200,000	120,100	52,100	Catalytic Hydrocracking Viscoreduction	23,500 13,400 14,400	Catalytic	23,000
Ultramar Canada Inc., Saint-Romuald (Québec)	5,000,000	103,000	33,000	Catalytic	34,600	Catalytic	14,800
All refineries	**9,201,000**	**310,600**	**126,000**	**Total** **— catalytic** **— hydrocracking** **— viscoreduction** **— canmet**	**135,300** **75,300** **27,800** **27,200** **5,000**	**Total**	**68,900**

Refinery	Hydrogenation units: Process	Hydrogenation units: Quantity[2]	Other units: Process	Other units: Quantity[2]	Usual origin of crude oil deliveries
Petro-Canada, Pointe-aux-Trembles, Montreal	Hydrodesulfurization — naphtha — distillates	 27,000 15,000	Sulfuric acid alkylation Catalytic polymerization Asphalt Petrochemicals — benzene, toluene, xylene	2,300 1,700 14,400 9,100	Mexico Middle East Western Canada Venezuela
Shell Canada Ltd., Montreal-Est	Hydrodesulfurization — naphtha — distillates — naphtha/kerosene — alimentation (u.c.c.)	 4,500 26,500 29,400 8,300	Hydrofluoric acid alkylation Asphalt Lubricating oils	3,800 11,000 3,400	North Sea Mexico Middle East Western Canada Venezuela
Ultramar Canada Inc., Saint-Romuald (Quebec)	Hydrodesulfurization — naphtha — distillates	 13,800 10,300	Catalytic polymerization Asphalt	6,300 20,000	North Sea Mexico Venezuela
All refineries	**Total**	**134,800**	**Alkylation** **Catalytic polymerization** **Asphalt** **Lubricating oils** **Petrochemicals**	**6,100** **8,000** **45,400** **3,400** **9,100**	**North Sea** **Mexico** **Middle East** **Western Canada** **Venezuela**

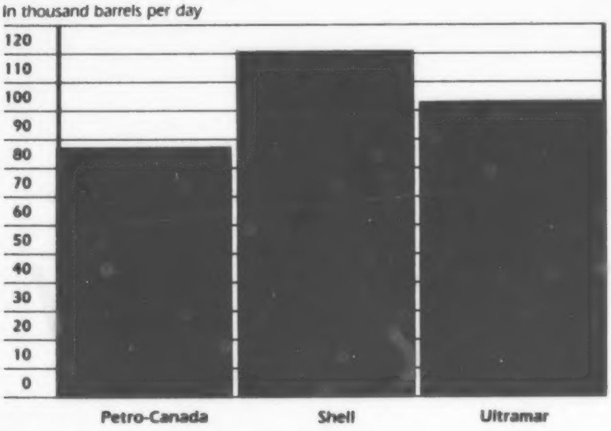
[1] In barrels.

[2] In barrles per calendar day (including service stoppage).

Sources: Canadian Petroleum Association and the ministere de l'Energie et des Ressources du Quebec.

Graph 7.7

REFINERY CAPACITIES IN QUÉBEC AS OF DECEMBER 31, 1987



Graph 7.8

DISTRIBUTION OF THE REFINING CAPACITY IN CANADA, BY PROVINCE

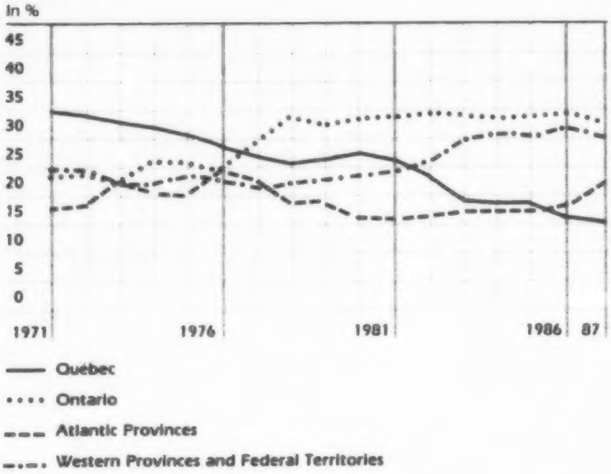


Table 7.4

DISTRIBUTION OF THE REFINING CAPACITY IN CANADA, BY PROVINCE 1971-1987

	Quebec		Atlantic Provinces		Ontario		Western Provinces and Federal Territories		Canada	
Year	Thousand barrels per day	%	Thousand barrels per day	%	Thousand barrels per day	%	Thousand barrels per day	%	Thousand barrels per day	%
1971	577.5	34.47	294.3	17.56	389.2	23.23	414.5	24.74	1,675.5	100.00
1972	587.5	33.95	312.5	18.06	410.8	23.74	419.5	24.25	1,730.3	100.00
1973	608.5	32.76	414.0	22.29	413.7	22.28	421.1	22.67	1,857.3	100.00
1974	646.6	31.96	414.5	20.49	522.7	25.83	439.5	21.72	2,023.3	100.00
1975	644.1	30.92	415.8	19.96	540.3	25.94	482.8	23.18	2,083.0	100.00
1976	645.8	28.72	546.0	24.28	549.6	24.45	506.9	22.55	2,248.3	100.00
1977	645.8	26.71	548.9	22.70	708.1	29.29	515.0	21.30	2,417.8	100.00
1978	618.2	25.54	448.9	18.54	817.4	33.76	536.4	22.16	2,420.9	100.00
1979	617.4	26.17	448.9	19.02	758.2	32.13	535.1	22.68	2,359.6	100.00
1980	619.3	27.21	367.0	16.12	758.0	33.30	532.1	23.37	2,276.4	100.00
1981	590.2	26.33	354.6	15.82	755.7	33.72	540.9	24.13	2,241.4	100.00
1982	515.7	23.50	354.6	16.16	755.7	34.44	568.5	25.90	2,194.5	100.00
1983	392.0	19.12	354.3	17.29	692.0	33.76	611.4	29.83	2,049.7	100.00
1984	387.0	18.76	352.5	17.09	689.4	33.42	633.8	30.73	2,062.7	100.00
1985	387.0	18.87	352.5	17.19	689.4	33.62	621.8	30.32	2,050.7	100.00
1986	310.6	15.91	352.5	18.06	669.9	34.31	619.2	31.72	1,952.2	100.00
1987	310.6	15.12	452.5	22.04	669.2	32.59	621.2	30.25	2,053.5	100.00

Sources: **Petroleum Refineries in Canada**, December 1981, Energy, Mines and Resources Canada, the Canadian Petroleum Association and the ministere de l'Energie et des Ressources du Quebec.

Table 7.5

REFINING CAPACITY UTILIZATION RATES
1971-1987

In %

Year	Québec	Atlantic Provinces	Ontario	Canada
1971	89.4	92.9	97.3	92.2
1972	90.0	86.0	93.6	90.3
1973	94.0	83.3	98.3	93.5
1974	85.3	85.3	96.7	91.3
1975	78.9	75.7	84.2	83.2
1976	84.3	54.6	83.5	79.1
1977	86.3	51.8	80.3	77.5
1978	83.2	56.6	71.6	73.9
1979	82.3	70.4	76.5	81.6
1980	81.1	67.4	78.5	82.0
1981	78.5	59.9	73.3	78.1
1982	75.7	40.9	64.4	68.8
1983	76.4	40.2	68.6	68.8
1984	81.7	39.6	75.6	71.6
1985	78.2	41.7	73.3	70.7
1986	84.5	53.1	73.3	73.1
1987	89.1	53.6	74.5	75.7

Note: Utilization rates were calculated on the basis of the average refining capacity for the whole year.

Table 7.6

REFINING CAPACITY AROUND THE WORLD
1975-1987

In thousand barrels per day

	1975	1980	1982	1983	1984	1985	1986	1987
North America	17,318	20,526	19,055	17,915	17,723	17,511	17,412 rd	17,749 pd
Canada	*2,083*	*2,276*	*2,195*	*2,050*	*2,063*	*2,051*	*1,952*	*2,054 pd*
United States	*15,235*	*18,250*	*16,860*	*15,865*	*15,660*	*15,460*	*15,460*	*15,695 pd*
Latin America	7,400	8,840	8,735	8,305	7,930	7,265 rd	7,340 rd	7,420 pd
Africa	1,270	2,060	2,355	2,340	2,540	2,555	2,550	2,630 pd
Middle East	2,750	3,565	3,565	3,560	3,515	3,810	3,850	4,120 pd
Far East and Oceania	9,435	10,780	10,785	10,530	10,655 rd	10,635 rd	10,515 rd	10,275 pd
Western Europe	20,390	20,055	17,705	16,635	15,285	14,665	14,330 rd	14,010 pd
Eastern Europe, U.S.S.R. and China[1]	12,645	15,510	16,920	17,220	17,320	17,320	17,695 rd	17,880 pd
Total	**71,208**	**81,336**	**79,120**	**76,505**	**74,968 rd**	**73,761 rd**	**73,692 rd**	**74,084 pd**

pd: preliminary data
rd: revised data
1. Including the other communist countries.
Sources: **BP Statistical Review of World Energy** and the Canadian Petroleum Association.

Table 7.7

VOLUME OF CRUDE OIL PROCESSED AROUND THE WORLD
1975-1987

In thousand barrels per day

	1975	1980	1982	1983	1984	1985	1986	1987
North America	14,183	15,416	13,301	13,144	13,516	13,459	14,151 rd	14,372 pd
Canada	*1,708*	*1,896*	*1,526*	*1,459*	*1,471*	*1,454*	*1,436*	*1,517 pd*
United States	*12,475*	*13,520*	*11,775*	*11,685*	*12,045*	*12,005*	*12,715 rd*	*12,855 pd*
Latin America	5,515	6,460	6,080	5,825	5,715	5,450 rd	5,480 rd	5,530 pd
Africa	1,005	1,460	1,735	1,920	1,975	2,015	2,095	2,170 pd
Middle East	2,075	2,445	2,245	2,515	2,665	2,795	2,950	2,970 pd
Far East and Oceania	6,720	7,730	7,160	7,120	7,310	7,370	7,465 rd	7,375 pd
Western Europe	12,415	12,330	10,075	9,710	9,790	9,490	10,060 rd	9,795 pd
Eastern Europe, U.S.S.R. and China[1]	11,025	13,320	13,575	13,675	13,885	14,165	14,500 rd	14,700 pd
Total	**52,938**	**59,161**	**54,171**	**53,909**	**54,856**	**54,744 rd**	**56,701 rd**	**56,912 pd**

pd: preliminary data
rd: revised data
1. Including the other communist countries.
Sources: **BP Statistical Review of World Energy** and Statistics Canada, catalogue 45-004.

IMPORTS AND EXPORTS OF ENERGY-RELATED PETROLEUM PRODUCTS

For Québec, 1987 was marked by continued deterioration in the external trade of energy-related petroleum products. The change can be seen in the sizeable increase in imports from abroad and in the sharp decrease in Québec's exports to other Canadian provinces. The total volume of imported energy-related petroleum products rose by nearly 10% and reached 5.6 million toe, compared to 5.2 million toe in 1986. Conversely, exports to other Canadian provinces fell by 15.1%, from 3.6 million toe to 3.1 million toe. The size of this trade deficit was somewhat mitigated by the growth of overseas exports and the decline in imports from other Canadian provinces. In all, in 1987, Québec's balance of trade for energy-related petroleum products scored a deficit of slightly more than 1.7 million toe.

Table 7.8

QUÉBEC'S IMPORTS AND EXPORTS OF ENERGY-RELATED PETROLEUM PRODUCTS[1]

1971-1987

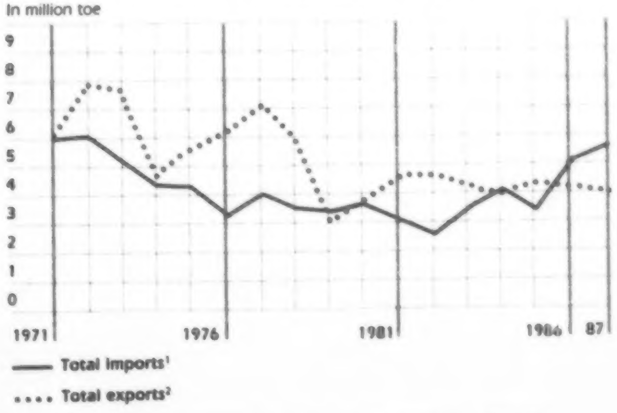
In toe

	Imports		Exports		Trade balance		Balance
Year	From abroad	From other Canadian provinces	Abroad	To other Canadian provinces	With foreign markets	With other Canadian provinces	of total trade
1971	4,748,548	1,271,817	551,870	5,478,348	– 4,196,678	4,206,531	9,853
1972	4,448,264	1,694,510	1,904,440	6,010,840	– 2,543,824	4,316,330	1,772,506
1973	3,233,118	1,969,759	2,301,241	5,347,537	– 931,877	3,377,778	2,445,901
1974	2,229,150	2,144,863	568,873	4,101,361	– 1,660,277	1,956,498	296,221
1975	1,361,321	2,890,261	925,959	4,718,361	– 435,362	1,828,100	1,392,738
1976	1,275,278	1,983,098	1,285,437	4,809,057	10,159	2,825,959	2,836,118
1977	2,115,337	1,894,038	1,456,651	5,617,707	– 658,686	3,723,669	3,064,983
1978	1,813,682	1,696,163	1,569,940	4,465,949	– 243,742	2,769,786	2,526,044
1979	424,784	2,929,327	260,535	2,699,610	– 164,249	– 229,717	– 393,966
1980	735,924	2,823,044	368,724	3,456,262	– 367,200	633,218	266,018
1981	673,514	2,452,754	562,081	4,005,016	– 111,433	1,552,262	1,440,829
1982	455,585	1,990,936	819,180	3,776,266	363,595	1,785 330	2,148,925
1983	1,147,137	2,612,841	538,805	3,689,247	– 608,332	1,076,406	468,074
1984	1,921,936	1,980,488	888,867	2,962,270	– 1,033,069	981,782	– 51,287
1985	1,633,669	1,788,517	1,084,463	3,214,907	– 549,206	1,426,390	877,184
1986	2,708,702	2,409,856	563,513	3,595,461	– 2,145,189	1,185,605	– 959,584
1987	3,283,179	2,345,034	849,716	3,052,930	– 2,433,463	707,896	– 1,725,567

1. Includes gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke, liquefied petroleum gas (except the liquefied petroleum gas classified as primary energy) and still gas.

Graph 7.9

QUÉBEC'S IMPORTS AND EXPORTS OF ENERGY-RELATED PETROLEUM PRODUCTS



1. Includes imports from foreign countries and other provinces of Canada.
2. Includes exports to foreign countries and other provinces of Canada..

FUEL DISTRIBUTION

As of December 31, 1987, there were 6,554 distribution gasoline stations in Québec, about the same number as in 1986. This stabilization of the number of gasoline stations, which ended a period of decline begun in 1978, was partly the result of an increase of more than 2% in fuel sales in 1987.

As of December 31, 1987, approximately 60% of the gasoline stations were located in the administrative regions of Montréal and Québec City. Nonetheless, areas at a distance from large urban centers continue to have the highest number of gasoline stations per capita.

The increase in the number of self-service stations peaked in 1987. As of December 31, 1987, approximately 1,100 self-service stations represented 17% of the total number of gasoline sales outlets in Québec. The share of the market controlled by self-service stations was 32% in 1987, more or less the same proportion as has been noted since 1982.

Distribution of the volume of gasoline sales by type of product indicates that, once again in 1985, there was a sharp drop in leaded gasoline sales, in favor of unleaded gasoline and diesel fuel. In one year, the share of leaded gasoline dropped from 26.5% to 19.5%, while the shares of unleaded gasoline and diesel fuel rose from 63.9% to 69.4% and from 9.6% to 11.1%, respectively. Although diesel fuel represents only a relatively small percentage of total gasoline sales, sales nevertheless shot up once again in 1987, this time by 19.2%.

Gasoline distribution in Québec is largely controlled by integrated companies, which shared 79.8% of the gasoline market in 1987, through the operations of their own stations or those of affiliated stations using their trademarks. Independent distributors controlled the remaining 20.2% of the market. Compared to 1986, the independents increased their share of the market to the detriment of the integrated companies.

Table 7.9

NUMBER OF GAS STATIONS, BY ADMINISTRATIVE REGION AS OF DECEMBER 31, 1987

	Self-service		With service			
Regions	**Tenant dealers**	**Owner dealers**	**Tenant dealers**	**Owner dealers**	**Total stations[1]**	**Stations per thousand inhabitants**
Bas-Saint-Laurent – Gaspésie	25	25	69	317	436	1.84
Saguenay – Lac-Saint-Jean	31	31	118	198	378	1.23
Québec	158	61	237	853	1,309	1.24
Trois-Rivières	27	30	112	405	574	1.27
Estrie	29	11	85	156	281	1.15
Montréal	435	162	965	1,178	2,740	0.73
Outaouais	37	8	90	224	359	1.43
Abitibi – Témiscamingue	10	4	47	223	284	1.85
Côte-Nord	13	9	42	99	163	1.56
Nouveau-Québec			4	26	30	2.81
Québec as a whole	765	341	1,769	3,679	6,554	1.00

1. Does not include 106 dealers not classified elsewhere.
Source: Direction des produits pétroliers, ministère de l'Énergie et des Ressources du Québec.

Table 7.10

VOLUME OF GASOLINE SALES, BY ADMINISTRATIVE REGION
1987

In thousand barrels

Regions	Self-service Tenant dealers	Self-service Owner dealers	With service Tenant dealers	With service Owner dealers	Total volume[1]
Bas-Saint-Laurent – Gaspésie	218	169	288	852	1,527
Saguenay – Lac-Saint-Jean	325	182	683	849	2,039
Québec	1,726	509	1,813	3,352	7,400
Trois-Rivières	319	252	712	1,931	3,215
Estrie	339	74	484	639	1,537
Montréal	6,254	2,073	7,315	5,952	21,594
Outaouais	514	32	665	840	2,050
Abitibi – Témiscamingue	102	80	266	744	1,193
Côte-Nord	108	51	249	283	692
Nouveau-Québec			16	51	67
Québec as a whole	9,905	3,422	12,491	15,493	41,314

1. Does not include 435,000 barrels not classified elsewhere.
N.B.: The data in this table are subject to revision.
Source: Direction des produits pétroliers, ministère de l'Énergie et des Ressources du Québec.

Table 7.11

VOLUME OF GASOLINE SALES, BY PRODUCT SOLD
1987

In thousand barrels

	Leaded gasoline regular	Unleaded gasoline regular	Unleaded gasoline super	Diesel fuel
Self-service stations	2,148	6,921	3,492	838
Stations with service	5,909	13,051	5,335	3,785
Total volume	8,057	19,972	8,827	4,623

Source: Direction des produits pétroliers, ministère de l'Énergie et des Ressources du Québec.

Table 7.12

VOLUME OF GASOLINE SALES, BY AGENT
1987

Agent	Gasoline sales thousand barrels	Gasoline sales %
Refiner	33,355	79.81
Independent	8,438	20.19

Source: Direction des produits pétroliers, ministère de l'Énergie et des Ressources du Québec.

DOMESTIC CONSUMPTION OF ENERGY-RELATED PETROLEUM PRODUCTS

In 1987, there was a renewed downturn in Québec's consumption of energy-related petroleum products. This consumption dropped 2.6%, compared to 1986, from 13.0 million toe to 12.7 million toe. Since the last oil shock in 1979, domestic consumption of energy-related petroleum products fell 42.8%.

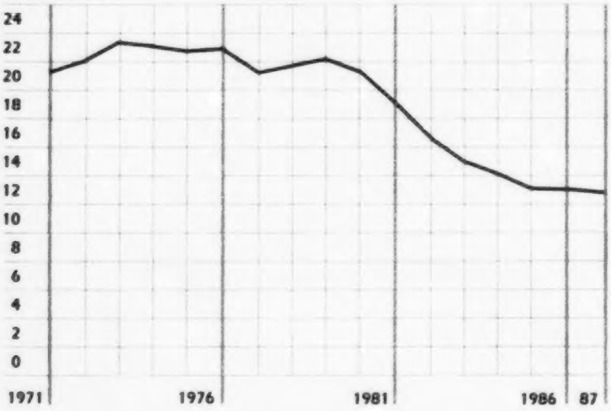
The 1987 decrease in consumption is mainly due to the drop in the sale of petroleum heating fuels (heavy fuel oil and light fuel oil). Consumption of these two products fell by 19.0% and 13.0%, respectively, in the space of one year. Conversely, there was a significant increase in fuel sales (12.3% for jet fuel consumption, 5.5% for diesel fuel and 0.9% for gasoline). Liquified petroleum gas consumption, which had slumped 18.5% in 1986, increased by 20.8% in 1987.

These fluctuations have altered the share of the various energy-related petroleum products in the overall energy consumption. The share of gasoline in the total consumption of energy-related petroleum products increased from 43.3% to 45.0%, while that of middle distillates rose from 42.1% to 42.3%. The share of heavy fuel oil fell from 12.6% to 10.5%.

Graph 7.10

OIL CONSUMPTION

In million toe



In 1987, the consumption of petroleum products fell sharply in all sectors with the exception of the transportation sector, which rose 3.6%. The residential and industrial sectors continued to drop by 13.4% and 9.5%, respectively, while consumption in the commercial sector, after having picked up last year, fell by 13.4%. Overall, the transportation sector now accounts for almost 63% of the oil consumption total.

In 1984, three industrial branches (paper and related products, mining, and ore processing) accounted for a combined total of 64.8% of the oil consumption in the mining and manufacturing industries.

Table 7.13

DOMESTIC CONSUMPTION OF ENERGY-RELATED PETROLEUM PRODUCTS 1971-1987

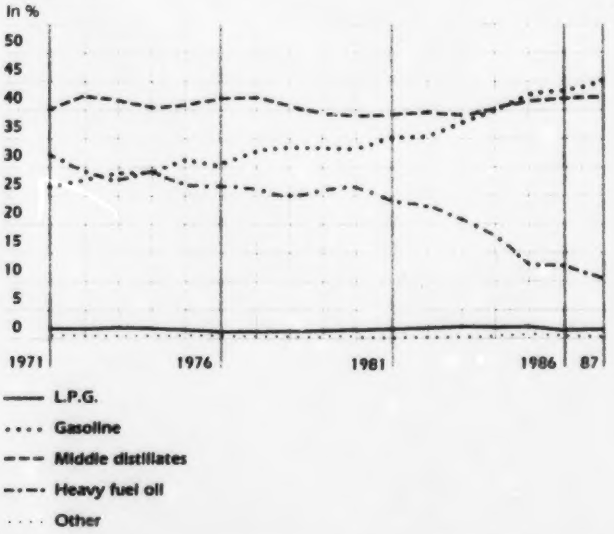
	1971		1975		1979		1983	
Product	**toe**	**%**	**toe**	**%**	**toe**	**%**	**toe**	**%**
L.P.G.[1]	285,307	1.35	314,244	1.39	282,710	1.27	330,081	2.21
Gasoline[2]	5,576,825	26.31	7,035,756	31.12	7,366,527	33.23	5,639,763	37.70
Middle distillates	8,432,008	39.77	9,167,044	40.55	8,747,685	39.46	5,833,508	38.99
Jet fuel	*682,696*	*3.22*	*888,923*	*3.93*	*865,253*	*3.90*	*612,394*	*4.09*
Diesel fuel	*1,209,320*	*5.70*	*1,856,006*	*8.21*	*2,449,486*	*11.05*	*1,940,104*	*12.97*
Light fuel oil[3]	*6,539,992*	*30.85*	*6,422,115*	*28.41*	*5,432,946*	*24.51*	*3,281,010*	*21.93*
Heavy fuel oil	6,873,824	32.43	6,024,426	26.64	5,739,785	25.89	3,127,560	20.91
Other[4]	30,103	0.14	68,008	0.30	32,308	0.15	28,255	0.19
Total	**21,198,067**	**100.00**	**22,609,478**	**100.00**	**22,169,015**	**100.00**	**14,959,167**	**100.00**

	1984		1985		1986		1987	
Product	**toe**	**%**	**toe**	**%**	**toe**	**%**	**toe**	**%**
L.P.G.[1]	268,144	1.90	288,326	2.20	194,667	1.49	235,092	1.85
Gasoline[2]	5,617,094	39.76	5,596,886	42.79	5,653,402	43.27	5,701,400	44.95
Middle distillates	5,709,325	40.41	5,456,024	41.70	5,455,743	42.12	5,359,548	42.25
Jet fuel	*700,646*	*4.96*	*725,069*	*5.54*	*728,850*	*5.58*	*818,712*	*6.45*
Diesel fuel	*2,183,433*	*15.45*	*2,187,824*	*16.72*	*2,310,666*	*17.69*	*2,438,560*	*19.22*
Light fuel oil[3]	*2,825,246*	*20.00*	*2,543,131*	*19.44*	*2,416,227*	*18.85*	*2,102,276*	*16.58*
Heavy fuel oil	2,532,631	17.92	1,654,635	12.65	1,645,652	12.60	1,332,854	10.51
Other[4]	2,028	0.01	86,359	0.66	68,241	0.52	55,286	0.44
Total	**14,129,222**	**100.00**	**13,082,230**	**100.00**	**13,017,705**	**100.00**	**12,684,180**	**100.00**

1. Liquefied petroleum gas.
2. Also includes aviation gasoline.
3. Includes kerosene.
4. Includes petroleum coke and still gas.

Graph 7.11

CONSUMPTION OF ENERGY-RELATED PETROLEUM PRODUCTS



DISTRIBUTION OF PETROLEUM PRODUCTS[1] CONSUMED BY SECTOR[2]

1971-1987

	Residential sector		Commercial sector		Transportation sector		Industrial sector	
Year	**toe**	**%**	**toe**	**%**	**toe**	**%**	**toe**	**%**
1971	5,151,107	24.79	3,220,309	15.50	7,858,734	37.82	4,548,482	21.89
1972	5,251,354	24.13	3,010,883	13.83	8,343,850	38.34	5,158,273	23.70
1973	5,068,891	21.97	2,752,078	11.93	9,414,216	40.80	5,837,265	25.30
1974	5,264,479	23.04	2,689,988	11.77	9,047,604	39.59	5,849,508	25.60
1975	5,325,261	23.80	2,189,889	9.78	9,332,099	41.70	5,532,768	24.72
1976	5,295,386	23.13	3,062,663	13.38	9,690,147	42.34	4,840,341	21.15
1977	4,564,664	21.41	2,471,269	11.59	9,721,990	45.61	4,558,352	21.39
1978	4,484,097	20.79	2,528,125	11.72	9,928,330	46.02	4,631,418	21.47
1979	4,674,242	21.42	2,292,673	10.50	10,046,404	46.03	4,811,882	22.05
1980	4,364,656	20.40	2,338,167	10.93	10,238,782	47.86	4,452,770	20.81
1981	3,645,908	18.99	2,439,420	12.70	9,180,946	47.81	3,935,883	20.50
1982	3,343,029	20.15	2,289,347	13.80	7,697,325	46.40	3,259,556	19.65
1983	2,790,334	18.66	2,178,504	14.56	7,347,492	49.13	2,639,758	17.65
1984	2,294,159	16.25	2,106,868	14.92	7,540,676	53.40	2,179,066	15.43
1985	2,342,474	17.91	1,445,548	11.05	7,685,866	58.76	1,605,341	12.28
1986	2,190,908	16.79	1,536,063	11.78	7,721,779	59.19	1,597,196	12.24
1987	1,898,232	14.97	1,331,038	10.50	8,002,189	63.12	1,446,156	11.41

[1] Including the following products gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum code, liquefied petroleum gas and still gas

[2] Other utilizations excluded

SHARE OF EACH SECTOR IN OIL CONSUMPTION

1987

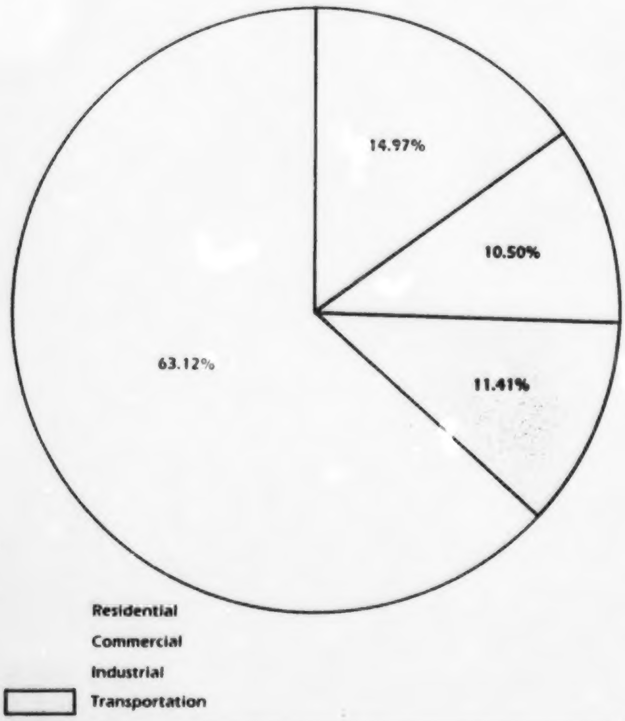


Table 7.15

OIL CONSUMPTION BY CERTAIN INDUSTRIES
1971-1984

	Mining		Food and alcohol		Paper and related products		Ore processing		Nonmetallic mineral products		Chemical products		Total mining and manufacturing industries
Year	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe	%	thousand toe
1971	438.43	8.81	442.21	8.89	1,930.94	38.81	634.97	12.76	390.45	7.85	334.97	6.73	4,974.89
1972	427.13	8.31	447.93	8.72	1,895.39	36.89	587.16	11.43	570.43	11.10	345.01	6.71	5,137.88
1973	562.40	11.24	438.11	8.76	1,730.81	34.59	559.29	11.18	614.93	12.29	305.89	6.11	5,003.79
1974	670.89	12.96	436.21	8.42	1,834.75	35.44	577.77	11.16	573.69	11.08	272.65	5.27	5,177.71
1975	553.39	12.63	405.27	9.25	1,482.33	33.82	474.03	10.82	514.01	11.73	240.67	5.49	4,382.42
1976	700.50	15.31	389.22	8.51	1,759.62	38.47	371.59	8.12	425.11	9.29	267.42	5.85	4,574.18
1977	702.39	15.55	366.94	8.12	1,699.06	37.62	489.30	10.83	324.77	7.19	285.70	6.33	4,516.76
1978	582.50	13.04	356.40	7.98	1,741.40	38.99	514.16	11.51	319.58	7.16	290.37	6.50	4,465.80
1979	768.03	16.26	365.70	7.74	1,745.45	36.95	463.72	9.82	436.03	9.23	292.44	6.19	4,724.10
1980	671.39	15.48	350.00	8.07	1,580.99	36.46	466.27	10.75	cd	cd	276.93	6.39	4,336.56
1981	529.22	13.46	324.64	8.26	1,540.88	39.20	465.31	11.84	269.97	6.87	cd	cd	3,930.57
1982	367.06	11.11	301.54	9.13	1,323.03	40.06	431.31	13.06	196.38	5.95	208.26	6.31	3,302.89
1983	317.30	11.24	270.26	9.57	1,149.58	40.71	324.71	11.50	169.56	6.00	129.83	4.60	2,823.93
1984	358.01	15.81	224.00	9.89	810.47	35.80	298.06	13.17	cd	cd	63.33	2.80	2,264.02

cd: confidential data
N.B.: For statistical reasons, it is impossible to compare these data with those provided in Table 7.14.
Source: Statistics Canada, catalogues 57-208 and 57-506.

NON-ENERGY USES OF OIL

Since none of the other data given in **Energy in Québec** take into account the non-energy uses of oil, these will be briefly covered here. In 1987, non-energy oil consumption represented about 1.2 million toe, or 8.4% of energy-related oil consumption, which marks a sharp increase (17.9%) over the consumption level in 1986.

Since 1982, there has been a substantial increase in the share of asphalt in the consumption of non-energy petroleum products. In 1987, asphalt consumption increased by 22.6% over 1986, and represented almost 74.3% of the consumption of non-energy petroleum products, compared to 71.4% in 1986 and 37.1% in 1982. On the other hand, the consumption of products used for petroleum feedstock seems to have stabilized in 1987. After the consumption of this kind of product plunged by 80% between 1982 and 1986, there was a slight increase (0.6%) in the consumption of products used for petrochemical feedstock in 1987. These products now represent only 15.2% of total consumption, compared to 17.8% in 1986 and 55.7% in 1982.

The petrochemical industry is concentrated in the Montréal area, and has four large plants. In April 1987, a consortium formed by the Montréal company Bitumar and the French company Elf-Aquitaine bought the asphalt factory of the ex-Gulf Canada refinery, in order to ensure continued operation of the plant. Moreover, in March 1988, the Lavalin engineering firm, through its subsidiary Kemtec, undertook to build a plant for the production of cumene and one for the processing of paraxylene in Montréal's east end. Québec's share in the Canadian production, after having continually declined since 1974, when it reached 51.3%, finally picked up in 1987, edging up from 9.0% in 1986 to 9.8% in 1987.

Table 7.16

MAIN CHARACTERISTICS OF PETROCHEMICAL PLANTS IN QUÉBEC
1987

Petrochemical plant	Location	Feedstock	Process	End product	Production capacity[1]
Pétromont	Varennes	Butane,	Steam cracking	Ethylene	225,000
		Propane, Propylène		Cracked gasoline	150,000
		Naphtha		Propylene	150,000
		Distillates		(polymere grade)	
		Concentrates		C_4 (blends)	75,000
				Industrial gas	10,000
Petro-Canada	Pointe-aux-Trembles	Reformate	Sulfolane	Benzene, toluene	180,000
				Xylenes (blends)	180,000
				Nonene	7,000
Kemtec	Montréal-Est	Cracked gasoline	Catalytic	Benzene, toluene	152,000
		Naphtha	reforming	Xylene	50,000
		Benzene	UDEX	Cyclohexane	100,000
			Toluene	Phenol	28,000
			dealkylation	Cumene	40,000[2]
				Acetone	15,000
Shell	Montréal-Est	Butane		Acetone, MIBC and MIBK	43,800

1. In tons per year.
2. Part of the quantities of BTX (benzene, toluene and xylene) produced may be retransformed into cyclohexane, phenol and cumene.

Sources: Ministère de l'Industrie et du Commerce du Québec, and ministère de l'Energie et des Ressources du Québec.

Table 7.17

PETROCHEMICAL FEEDSTOCK PRODUCTION — QUÉBEC AND CANADA
1971-1987

In thousand m^3

Year	Québec	Canada	Québec's share in Canadian production (%)
1971	745.8	1,713.8	43.5
1972	592.7	2,150.4	27.6
1973	810.7	1,926.2	42.1
1974	855.4	1,668.1	51.3
1975	636.8	1,420.8	44.8
1976	793.4	2,101.7	37.8
1977	1,192.4	3,719.5	32.1
1978	1,326.2	4,927.3	26.9
1979	1 441.9	5,739.1	25.1
1980	1,374.3	5,382.6	25.5
1981	1,241.4	5,291.3	23.5
1982	1,294.3	4,325.7	29.9
1983	1,152.9	4,286.4	26.9
1984	854.5	4,374.3	19.5
1985	703.9	4 387.1	16.0
1986	459.3	5,126.5	9.0
1987	400.8	4,098.6	9.8

Source: Statistics Canada, catalogues 45-004 and 57-003.

Table 7.18

CONSUMPTION[1] OF NON-ENERGY PETROLEUM PRODUCTS[2]
1971-1987

	Petrochemical feedstock		Asphalt		Lubricating oils and greases		Total	
Year	toe	%	toe	%	toe	%	toe	%
1971	755,530	49.34 rd	622,396	40.65 rd	153,265	10.01 rd	1,531,191 rd	100.00
1972	799,251	47.71 rd	714,180	42.64 rd	161,692	9.65 rd	1,675,123 rd	100.00
1973	902,872	46.52 rd	859,613	44.29 rd	178,447	9.19 rd	1,940,932 rd	100.00
1974	819,167	45.89 rd	788,584	44.17 rd	177,423	9.94 rd	1,785,174 rd	100.00
1975	686,350	44.42 rd	680,289	44.03 rd	178,560	11.55 rd	1,545,199 rd	100.00
1976	937,109	50.93 rd	753,264	40.93 rd	149,719	8.14 rd	1,840,092 rd	100.00
1977	1,120,078	53.54 rd	830,683	39.70 rd	141,422	6.76 rd	2,092,183 rd	100.00
1978	1,270,284	57.45 rd	781,301	35.34 rd	159,398	7.21 rd	2,210,983 rd	100.00
1979	1,274,989	56.58 rd	825,373	36.63 rd	153,022	6.79 rd	2,253,384 rd	100.00
1980	1,088,407	55.51 rd	741,370	37.81 rd	130,898	6.68 rd	1,960,675 rd	100.00
1981	924,844	53.73 rd	657,792	38.22 rd	138,503	8.05 rd	1,721,139 rd	100.00
1982	866,710	55.65 rd	577,612	37.08 rd	113,230	7.27 rd	1,557,552 rd	100.00
1983	713,648	50.02 rd	601,613	42.17 rd	111,386	7.81 rd	1,426,647 rd	100.00
1984	509,256	40.63 rd	622,747	49.69 rd	121,373	9.68 rd	1,253,376 rd	100.00
1985	380,220	31.99 rd	691,457	58.18 rd	116,840	9.83 rd	1,188,517 rd	100.00
1986	174,737	17.77 rd	702,289	71.43 rd	106,163	10.88 rd	983,189 dr	100.00
1987	175,745	15.17	861,162	74.32	121,757	10.51 rd	1,158,664	100.00

rd: revised data

1. Includes producer consumption.
2. The category "other products", representing 227,591 toe in 1987 has not been included. The compiled data did not make it possible to accurately distinguish energy-related from non energy-related uses of these products.

Source: Statistics Canada, catalogues 45-004 et 57-003.

8. NATURAL GAS

NATURAL GAS AVAILABILITY IN QUÉBEC

Québec produces only a small quantity of natural gas, and imports almost all the supplies it requires. From 1966 to 1976, the Laduboro oil company commercially operated a natural gas deposit in Pointe-du-Lac, near Trois-Rivières. During a ten-year period, this gas deposit met the needs of several industrial consumers in that area. By March 1976, when operations ended, the cumulative production of Pointe-du-Lac (total amount of gas from the deposit) was 41.6 million m^3.

In the last few years, SOQUIP has made a number of discoveries, and its exploration activities in Québec have confirmed the existence of promising structures, especially in the St. Lawrence lowlands on the Gaspé peninsula. In 1975, the first encouraging results were the discovery of a deposit in Saint-Flavien, followed by the identification of significant signs in the fractured clay zone between Villeroy and Saint-Hyacinthe. The Saint-Flavien deposit has been commercially operated since 1980, and supplies several industrial clients; the gas is compressed prior to shipment in fuel trucks. A small pipeline was built in 1983 to transport the gas from Saint-Flavien to Saint-Agapit, where it would help increase production. Between 1980 and 1987, production at the Saint-Flavien deposit climbed from 3.9 million m^3 to 13.2 million m^3 per year. The total production of this deposit since operations began is 71.9 million m^3. As of March 31, 1988, the proven reserves of this deposit had been established at 102.9 million m^3.

Except for the volume of gas from the Saint-Flavien deposit, all natural gas consumed in Québec is imported from Alberta. In 1987, Québec imported 5.6 billion m^3 (of which a portion came from the reserves controlled by SOQUIP in western Canada through Sceptre Resources), a 2.8% increase over 1986. Some of this imported gas was reexported to the Vermont Gas System via the TransCanada PipeLines station at Phillipsburg in the Eastern Townships. In 1987, these exports amounted to 154.2 million m^3, or 8.7 million m^3 (6.0%) more than in 1986.

The total amount of natural gas available for consumption in Québec in 1987 (including Québec's own gas production) totalled 5.0 billion m^3. With the extension of Québec's gas network, undertaken in 1980, the province has significantly increased its share in Canada's natural gas market. Between 1971 and 1986, Québec's relative share in the Canadian market more than doubled, climbing from 5.3% to 11.1%.

Table 8.1

NATURAL GAS SITUATION IN QUÉBEC
1971-1987

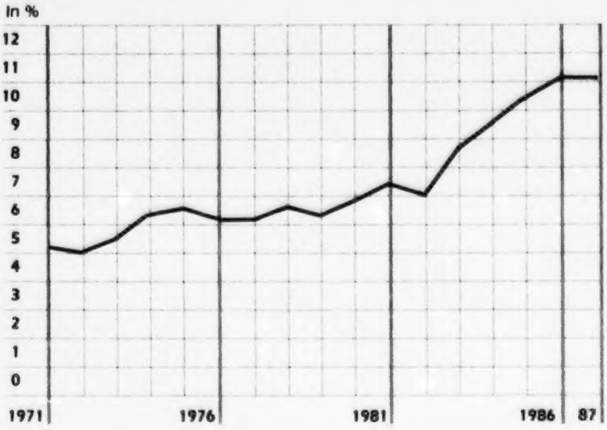
In thousand m^3

Year	Production	Imports		Exports		Producer consumption	Stock variation	Available primary energy
		From abroad	From other Canadian provinces	Abroad	To other Canadian provinces			
1971	4,800		1,634,900	79,900	400	11,700	4,300	1,543,400
1972	5,300		1,740,000	106,100	1,400	13,400	−8,900	1,633,300
1973	5,600		1,922,100	110,800	800	14,500	18,000	1,783,600
1974	5,200		2,356,600	138,600	3,700	7,300	4,600	2,207,600
1975	1,400		2,443,600	116,800		11,100	39,500	2,277,600
1976	1,250		2,434,200	115,100		14,200	6,200	2,298,900
1977	400		2,558,900	120,700		9,600	10,100	2,418,500
1978			2,846,400	119,700		−900	84,100	2,643,500
1979			3,049,300	128,800		−300	142,200	2,778,600
1980	3,900		3,233,200	119,500			233,800	2,883,800
1981	4,700		3,518,600	130,000			175,300	3,218,000
1982	3,700		3,322,100	128,000			174,100	3,023,700
1983	4,700		3,944,400	130,600			137,400	3,681,100
1984	12,300		4,555,400	141,200			149,100	4,277,400
1985	14,000		5,230,500	147,500			56,700	5,040,300
1986	13,900 rd		5,407,400	145,500			249,600	5,026,200
1987	13,200		5,559,300	154,200			397,200	5,021,100

rd: revised data
Sources: Direction du gaz naturel, ministère de l'Énergie et des Ressources; Statistics Canada, catalogues 57-003 and 57-207; and SOQUIP inc.

Graph 8.1

QUÉBEC'S SHARE IN CANADA'S ENERGY GAS DEMAND[1]



[1] Including natural gas used for the production of secondary energy.

TRANSMISSION AND DISTRIBUTION

Natural gas from Alberta is transmitted through the TransCanada PipeLines system, whose main line stretches through Saskatchewan, Manitoba and Ontario to Toronto, before following the shores of Lake Ontario and the St. Lawrence to Montréal. A second line, connected to the Great Lakes Pipelines, passes from southern Manitoba, through the U.S. to Ontario. Finally, TransCanada PipeLines built a third line between North Bay and Cornwall significantly shortening the gas route between Alberta and Montréal, and making Toronto and Montréal almost equidistant from the Alberta border.

Until 1980, the pipeline ended at Montréal, although connectors from Ontario made it possible to supply distribution networks in Hull and Rouyn-Noranda. Since then, work on a major extension of the pipeline has been undertaken, first by TransQuébec & Maritimes, then by Gaz Inter-Cité Québec. This quickly changed the conditions under which gas is supplied to the Québec market. In 1984, the transmission network was expanded toward the Saguenay – Lac-Saint-Jean region, thus completing the expansion of infrastructures toward northeastern Québec. In 1985, the network was extended toward the Bois-Francs region, and a further extension was built in 1986 to link up Windsor with the city of Sherbrooke. Between 1980 and 1985, the last year for which statistics are available, the total length of gas transmission and distribution lines in Québec more than quadrupled, growing from 260 km to almost 1,200 km.

Over the past few years, major work has been done on the distribution network. Between 1981 and 1987, the total length of the gas distribution lines within the franchises of the distributors has virtually doubled, growing from 3,071 km to 5,871 km. In 1987, 156 kilometers of pipeline were added to the existing network. Construction of the transmission and distribution network has thus entered a consolidation phase, following a period of intensive development.

Despite the new extensions, there are still gaps in the transmission and distribution network, and this places Québec at a disadvantage. As of December 31, 1986, only 4.0% (5,715 km) of Canada's natural gas pipelines were located in Québec, compared to 27.4% (38,999 km) in Ontario.

The construction of new gas installations in Québec has called for major investments. Between 1981 and 1987, almost $1.7 billion were invested, of which $790 million went into the transmission network and $890 million into the distribution network. In 1987, investments in the natural gas industry rose to slightly more than $67.5 million and were focused particularly on distribution.

Prior to 1984, four companies distributed natural gas in Québec: Gaz Métropolitain in Montréal, Gazifère in Hull, Gaz Provincial du Nord de Québec in Rouyn-Noranda and Gaz Inter-Cité Québec, east of Montréal. The new territories opened to natural gas distribution after extension of the transmission network were franchised to Gaz Métropolitain and Gaz Inter-Cité Québec in 1981.

In 1985, there was a major reorganization of Québec's natural gas distribution system: in May 1985, Gaz Métropolitain purchased Gaz Inter-Cité Québec, Gaz Provincial du Nord de Québec and Champion Pipeline. As a result, Gaz Métropolitain now controls all natural gas sales in Québec, with the exception of what is sold by Gazifère in Aylmer, Gatineau and Hull. Early in the summer of 1986, a corporative reorganization brought about the creation of the Noverco holding (Nova Energie Compagnie), composed of Gaz Métropolitain, Métro Gaz Marketing, inc. and Energy Future Limited Partnership.

Graph 8.2

NATURAL GAS TRANSMISSION NETWORKS SERVING QUÉBEC AS OF SEPTEMBER 30, 1987

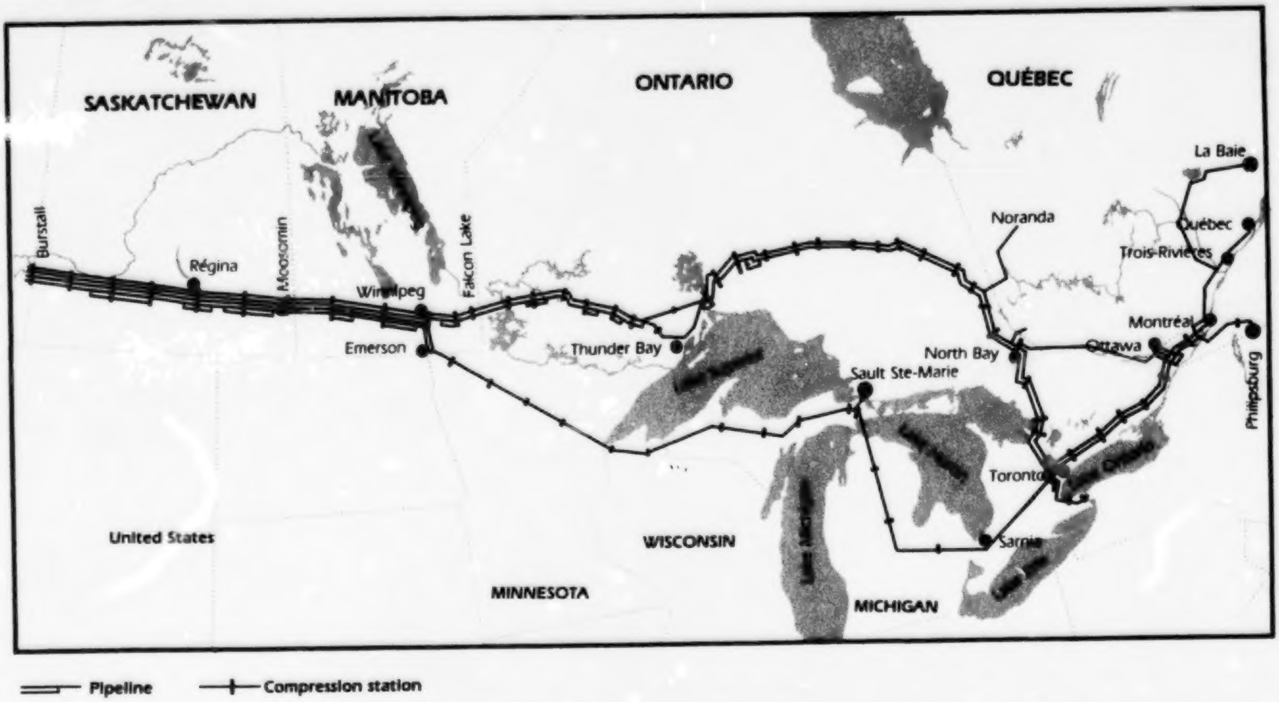

SASKATCHEWAN
MANITOBA
ONTARIO
QUÉBEC
La Baie
Québec
Noranda
Trois-Rivières
Burstall
Régina
Moosomin
Winnipeg
Falcon Lake
Emerson
Thunder Bay
Montréal
North Bay
Ottawa
Sault Ste-Marie
Philipsburg
Toronto
Sarnia
United States
WISCONSIN
MINNESOTA
MICHIGAN
Pipeline
Compression station

Table 8.2

LENGTH OF NATURAL GAS TRANSMISSION LINES IN QUÉBEC, BY DIAMETER 1971-1986[1]

In kilometers

Year	Outside diameter of pipes, in millimeters					
	76-150	151-226	227-328	329-531	532 and over	Total
1971		105.2	37.3	95.1		237.6
1972		105.2	37.3	95.1		237.6
1973		105.2	37.3	95.1		237.6
1974		105.2	37.3	95.1		237.6
1975		105.2	37.3	95.1		237.6
1976		105.2	37.3	95.1		237.6
1977		106.5	37.5	95.1	25.9	265.0
1978		106.4	28.6	95.3	26.1	256.4
1979		106.4	28.7	95.2	26.0	256.3
1980		106.5	28.7	95.2	26.0	256.4
1981		106.5	28.7	114.8	26.0	276.0
1982		106.5	28.7	127.7	26.0	288.9
1983		106.6	28.7	127.7	26.0	289.0
1984	0.9	150.8	108.9	519.1	325.4	1,105.1
1985	0.9	150.8	108.9	519.1	364.9	1,144.6
1986	0.9	150.8	108.9	519.1	322.2	1,101.9

1. As of December 31 each year.

Source: Statistics Canada, catalogue 57-205.

Table 8.3

INVESTMENTS[1] IN THE NATURAL GAS INDUSTRY 1971-1987

In millions of current dollars

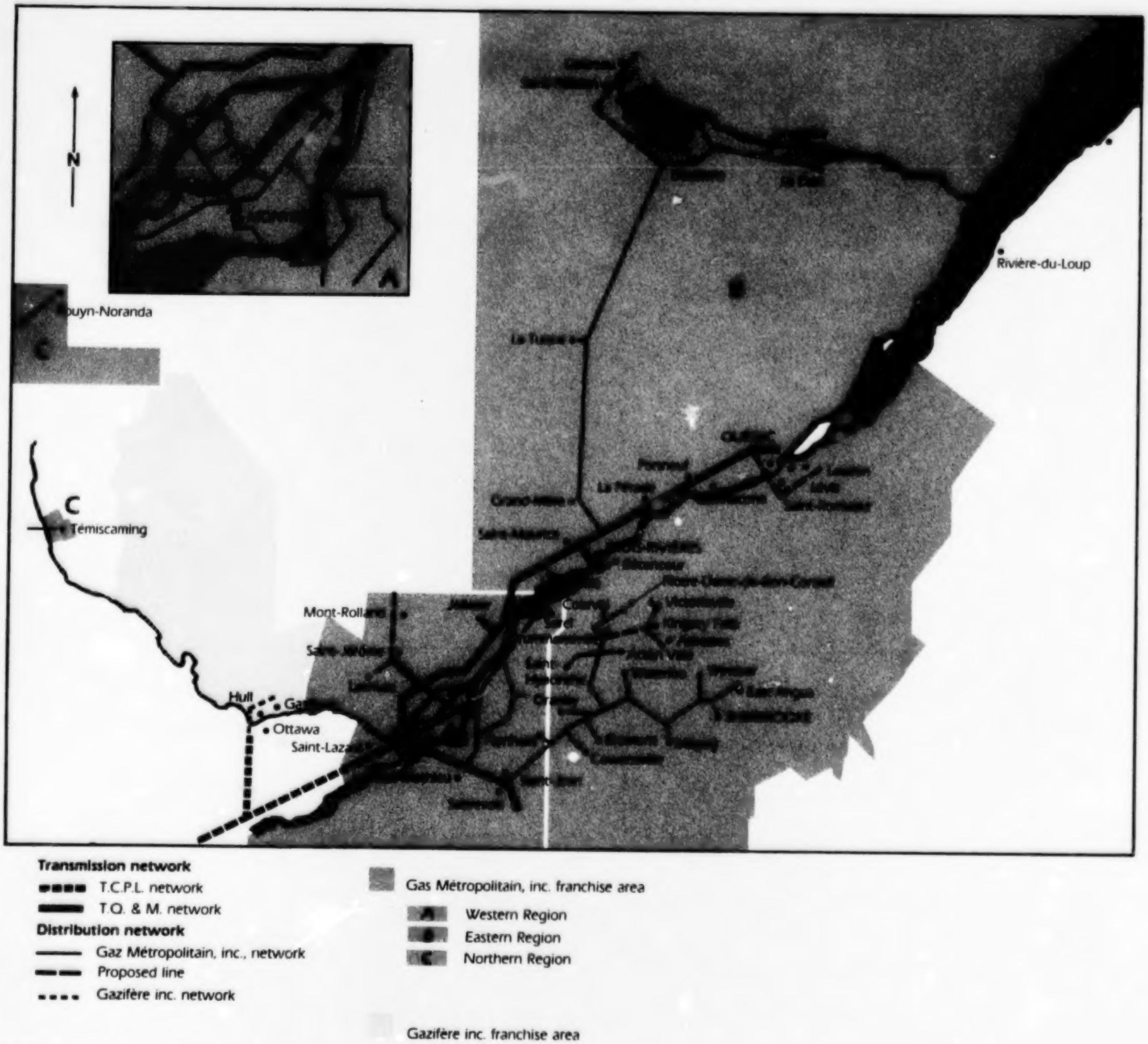
Year	Transmission Industry	Distribution Industry[2]	Natural gas industry as a whole
1971	ε	10.1	10.1
1972	0.3	13.1	13.4
1973	0.1	11.1	11.2
1974	ε	18.3	18.3
1975	0.1	22.9	23.0
1976	0.1	15.3	15.4
1977	5.4	15.6	21.0
1978	0.2	16.0	16.2
1979	ε	25.2	25.2
1980	0.4	30.7	31.1
1981	158.6	53.5	212.1
1982	133.6	120.8	254.4
1983	280.1	144.2	424.3
1984	131.2	259.6	390.8
1985	74.4	144.8	219.2
1986	8.9	97.9	106.8
1987	1.7	65.8	67.5

1. Including grants under various government programs, and construction assistance.
2. Before 1980, this item does not include investments made by TransCanada PipeLines and Gas Métropolitain, inc.

Source: Direction des études et statistiques of the ministère de l'Énergie et des Ressources du Québec.

Graph 8.3

NATURAL GAS TRANSMISSION NETWORKS IN QUÉBEC AND THE TERRITORY COVERED BY NATURAL GAS DISTRIBUTION FRANCHISES AS OF 31 DECEMBER, 1987


N
A
Rivière-du-Loup
ouyn-Noranda
C
C
Témiscaming
La Tuque
Mont-Rolland
Hull
Ottawa
Saint-Laza
Transmission network
T.C.P.L. network
T.Q. & M. network
Distribution network
Gaz Métropolitain, inc., network
Proposed line
Gazifère inc. network
Gas Métropolitain, inc. franchise area
A Western Region
B Eastern Region
C Northern Region
Gazifère inc. franchise area

Source: Direction générale des hydrocarbures du ministère de l'Énergie et des Ressources du Québec.

Table 8.4

LENGTH OF NATURAL GAS DISTRIBUTION PIPELINES[1] IN QUÉBEC, ONTARIO AND CANADA
1971-1986

	Québec		Ontario		Canada
Year	kilometers	% in Canada as a whole	kilometers	% in Canada as a whole	kilometers
1971	2,636.1	4.66	25,911.6	45.85	56,513.2
1972	2,724.3	4.56	26,718.5	44.75	59,711.3
1973	2,773.5	4.52	26,384.2	43.04	61,296.4
1974	2,764.7	4.37	27,395.1	43.32	63,233.7
1975	2,976.0	4.47	28,033.8	42.07	66,642.4
1976	2,890.9	4.11	28,715.7	40.78	70,409.5
1977	2,938.9	3.91	29,378.8	39.06	75,212.1
1978	2,972.1	3.83	29,444.1	37.92	77,648.5
1979	2,999.4	3.70	30,478.4	37.55	81,161.1
1980	3,028.9	3.54	31,836.9	37.23	85,512.3
1981	3,070.5	3.46	32,974.4	37.11	88,861.7
1982	3,501.9	3.81	34,220.6	37.22	91,942.8
1983	3,709.7	3.72	35,134.2	35.20	99,804.1
1984	4,358.9	3.84	36,637.9	32.30	113,423.6
1985	4,669.3	3.72	37,699.0	30.06	125,398.4
1986	5,715.2	4.02	38,999.0	27.42	142,212.3

[1] As of December 31 each year.

Source: Statistics Canada, catalogue 57-205.

DOMESTIC CONSUMPTION OF NATURAL GAS

In 1987, domestic consumption of natural gas reached 4.4 million toe, approximately the same level as in 1986. The share of natural gas in Québec's overall energy consumption stood at 14.8%, compared to 14.9% in 1986. Following a period of rapid growth, a certain stabilization in the evolution of natural gas consumption has thus taken place over the past two years. This is due in part to the decrease in crude oil prices and the ensuing increase in the competitiveness of petroleum products, as well as the continued penetration of electricity in the residential and commercial sectors.

Analysis of natural gas consumption per sector reveals a major swing toward the commercial sector in 1987. This may in large part be the result of statistical readjustments done by Statistics Canada. It is worth noting that the industrial sector remains Québec's principal user of natural gas, with about 62% of total consumption.

A more detailed analysis of natural gas consumption in the industrial sector shows that, in 1984 (the last year for which data are available) six industries ensured three quarters of the total consumption. Ore processing alone — which includes SIDBEC — accounted for 19% of the industrial consumption of gas and for 11% of Québec's total gas consumption.

Since 1983, the statistics indicate that natural gas is being used in the transportation sector. In that year, SOQUIP created the corporation GNC Québec ltée, in association with Gaz Métropolitain and CNG Fuel Systems, in order to promote the use of compressed natural gas as automobile fuel. However, while natural gas consumption by the transportation sector doubled between 1986 and 1987, this consumption still represents less than 0.24% of the total energy consumed by this sector.

Graph 8.4

NATURAL GAS CONSUMPTION IN QUÉBEC

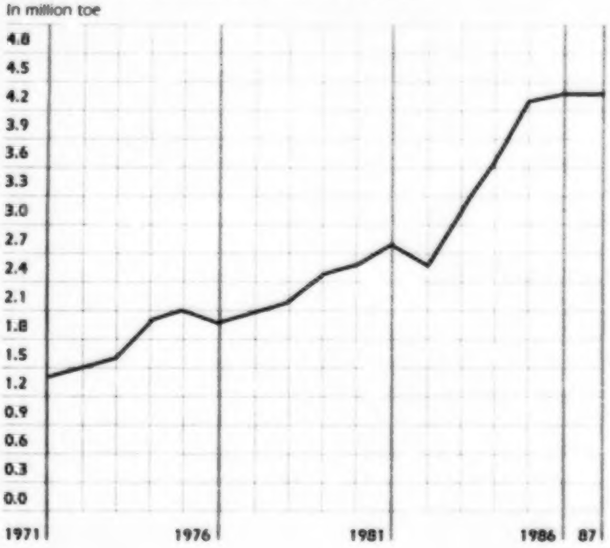


Table 8.5

NUMBER OF SUBSCRIBERS BY USER GROUP
1971-1986[1]

	Residential		Commercial		Industrial		Total
Year	number	%	number	%	number	%	number
1971	196,065	94.28	10,083	4.85	1,804	0.87	207,952
1972	187,012	94.24	9,981	5.03	1,447	0.73	198,440
1973	182,869	93.97	10,257	5.27	1,470	0.76	194,596
1974	179,642	93.68	10,658	5.56	1,457	0.76	191,757
1975	178,037	93.25	11,399	5.97	1,493	0.78	190,929
1976	174,347	93.02	11,617	6.20	1,466	0.78	187,430
1977	167,527	92.69	11,764	6.51	1,443	0.80	180,734
1978	162,550	92.50	11,774	6.70	1,408	0.80	175,732
1979	161,653	92.20	12,263	6.99	1,421	0.81	175,337
1980	160,830	91.84	12,860	7.34	1,443	0.82	175,133
1981	161,090	91.36	13,678	7.76	1,560	0.88	176,328
1982	164,254	90.86	14,899	8.24	1,633	0.90	180,786
1983	164,383	89.97	16,648	9.11	1,677	0.92	182,708
1984	164,735	88.82	18,999	10.19	1,830	0.99	185,464
1985	166,936	87.46	21,961	11.51	1,963	1.03	190,860
1986	153,131	84.76	25,442	14.08	2,098	1.16	180,671

1. As of December 31 of each year.
Source: Statistics Canada, catalogue 57-205

Table 8.6

NATURAL GAS CONSUMPTION BY SECTOR[1]
1971-1987

	Residential sector		Commercial sector		Transportation sector[2]		Industrial sector	
Year	thousand m^3	%	thousand m^3	%	thousand m^3	%	thousand m^3	%
1971	403,976	25.79	203,155	12.97			959,077	61.24
1972	466,127	28.30	219,634	13.33			961,402	58.37
1973	448,372	24.68	263,477	14.50			1,104,869	60.82
1974	486,473	21.43	298,660	13.16			1,484,547	65.41
1975	471,715	20.24	343,192	14.73			1,515,679	65.03
1976	536,472	23.56	404,549	17.77			1,335,684	58.67
1977	486,785	21.09	399,309	17.30			1,422,282	61.61
1978	462,800	18.83	453,200	18.43			1,542,500	62.74
1979	419,900	15.19	475,301	17.20			1,868,400	67.61
1980	526,900	18.04	504,201	17.26			1,890,303	64.70
1981	602,000	18.83	529,900	16.58			2,064,604	64.59
1982	581,601	19.56	629,200	21.16			1,762,400	59.28
1983	579,901	16.08	765,400	21.23	201	0.01	2,259,898	62.68
1984	639,999	15.17	914,300	21.71	1,700	0.04	2,657,000	63.08
1985	697,800	14.29	1,008,300	20.65	3,700	0.08	3,172,200	64.98
1986	731,057	14.79	1,328,703	26.87	7,400	0.15	2,877,523	58.19
1987	680,500	13.57	1,208,800	24.11	11,800	0.24	3,112,200	62.08

1. Excluding other uses.
2. Up to 1982, Statistics Canada made no mention of natural gas consumption in the transportation sector.

Table 8.7

NATURAL GAS CONSUMPTION BY CERTAIN MANUFACTURING INDUSTRIES
1971-1984

	Food and beverage industry		Paper and related activities		Ore processing		Nonmetallic mineral products[1]		Petroleum and coal products		Chemical products		Manufacturing industry total
Year	million m³	%	million m³	%	million m³	%	million m³	%	million m³	%	million m³	%	million m³
1971	134.2	17.74	57.7	7.63	172.0	22.74	184.3	24.36	4.3	0.57	76.9	10.17	756.4
1972	133.9	17.81	21.7	2.89	176.9	23.53	196.9	26.19	4.5	0.60	82.0	10.91	751.9
1973	141.7	16.88	21.6	2.57	231.1	27.52	183.2	21.82	13.0	1.55	77.8	9.26	839.7
1974	141.3	12.90	43.2	3.94	337.3	30.80	253.5	23.14	50.6	4.62	80.8	7.38	1,095.3
1975	171.9	13.64	37.4	2.97	425.9	33.79	233.0	18.49	50.1	3.98	111.2	8.82	1,260.4
1976	210.3	18.07	36.5	3.14	316.6	27.20	221.3	19.02	38.5	3.31	92.7	7.97	1,163.8
1977	167.2	13.65	38.7	3.16	395.0	32.24	234.7	19.16	23.5	1.92	139.3	11.37	1,225.2
1978	193.7	13.12	65.8	4.46	487.6	33.03	271.5	18.39	23.7	1.61	164.1	11.12	1,476.3
1979	181.4	10.68	95.2	5.60	591.5	34.82	238.1	14.02	139.2	8.20	169.0	9.95	1,698.5
1980	199.7	10.57	116.0	6.14	805.4	42.62	cd		101.1	5.35	163.9	8.67	1,889.5
1981	219.8	9.83	181.6	8.12	655.9	29.32	222.3	9.94	158.1	7.07	176.8	7.90	2,237.0
1982	240.4	13.33	164.6	9.13	449.7	24.94	173.8	9.64	177.6	9.85	221.7	12.30	1,803.0
1983	232.0	11.07	191.7	9.14	479.4	22.87	181.2	8.64	394.8	18.83	267.7	12.77	2,096.3
1984	229.0	9.00	327.4	12.87	476.2	18.72	cd		482.3	18.96	300.1	11.80	2,543.8

cd: confidential data

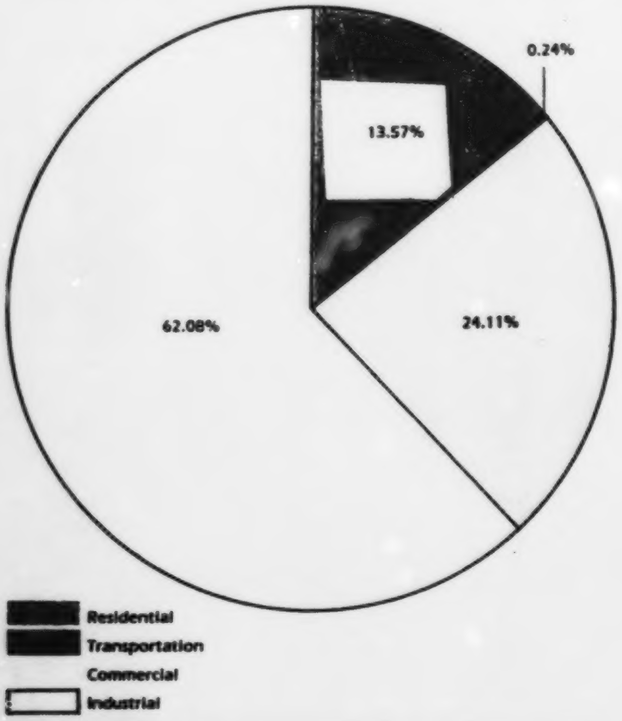
1. Including cement manufacturers.

N.B.: For statistical reasons, it is not possible to compare the data in this table with those in Table 8.6.

Source: Statistics Canada, catalogues 57-003, 57-208 and 57-506.

Graph 8.5

SHARE OF EACH SECTOR IN NATURAL GAS CONSUMPTION
1987



9. ALTERNATIVE ENERGY SOURCES

ALTERNATIVE ENERGY SOURCES

Alongside conventional energy sources such as oil, natural gas and electricity, there is a category of energy forms comprised of those whose use has been made possible only through recent technology, and those which, already known to energy consumers for some time, are now regaining popularity. The name of this category, "alternative energy sources," thus covers a wide range of energy sources, and refers to a number of very different techniques.

Biomass is in a category all by itself, among alternative energy sources. The word refers to all organic matter produced by vegetable growth, or by animal and human activity. Within this category, wood and lumbering residues make up what is known as "forest biomass," while waste from human activity in cities makes up urban biomass. In 1986, the quantity of biomass used for energy purposes was estimated at 2.9 million toe. According to available estimations, biomass consumption in 1986 may have increased by almost 13% over its 1985 levels. This growth took place in the industrial sector, where forest biomass consumption climbed from 1.6 million toe to 2.2 million toe in the space of one year. In the residential and institutional sectors, on the other hand, biomass utilization seems to have come to a relative standstill.

In the industrial sector, the use of forest biomass for energy purposes is closely linked to forestry operations. In fact, the major industries currently using this energy source are in the pulp and paper, wood processing and sawmill categories. In the residential sector, the use of forest biomass is part of a trend toward the use of wood as a primary or secondary source of home heating. As for Québec's urban biomass, it is now being treated in two public incinerators located in Montréal and Québec City, where the steam produced by waste combustion is sold to industrial and commercial customers.

The history of biomass consumption can be reconstituted from 1971 on. Although historical comparison would be risky because of the questionable reliability of the data, marked progress has been noted in the use of forest and urban biomass since 1976, when this form of energy penetrated the residential and industrial markets. In 1986, forest and urban biomass represented 9.0% in Québec's "expanded" total energy consumption chart, compared to 8.2% in 1985.

ALTERNATIVE ENERGY SOURCES IN QUÉBEC

Source	Technology applied	Energy obtained
Forest, urban and farm biomass, and peat moss	gasification	synthetic gas methanol ethanol
	hydrolysis	ethanol
	pyrolysis	various hydrocarbons
	combustion	heat
	bio-digestion	methane
Solar energy	active solar	heat
	passive solar	heat
	photocells	electricity
Atmospheric heat	air-air heat pump	heat
	water-air heat pump	heat
	heat exchanger	heat
Waste heat	heat pump	heat electricity
Water	electrolysis	hydrogen
	micro and mini-turbines	electricity
Wind energy	wind turbines	electricity mechanical energy
Nuclear energy	fusion	electricity

Table 9.1

UTILIZATION OF BIOMASS IN QUÉBEC FOR ENERGY PURPOSES 1971-1987

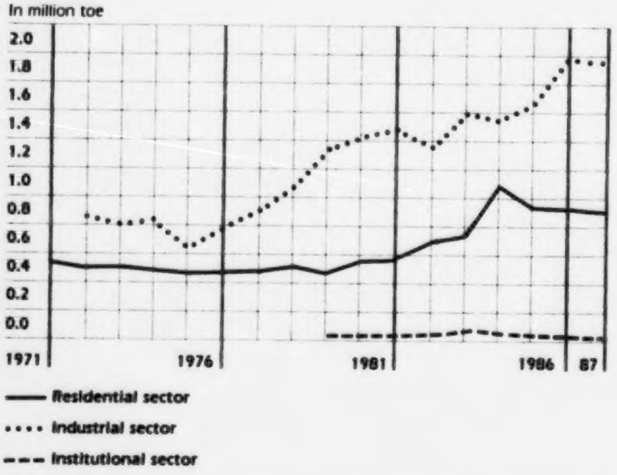
In toe

Year	Residential sector	Industrial sector	Institutional sector	Total
1971	552,000	na	2,100	na
1972	512,000	860,000	2,100	1,374,100
1973	511,000	818,000	2,100	1,331,100
1974	491,000	841,000	2,100	1,334,100
1975	473,000	636,000	2,100	1,111,100
1976	472,000	789,000	2,100	1,263,100
1977	480,000	898,000	2,100	1,380,100
1978	519,000	1,064,000	2,100	1,585,100
1979	483,000	1,347,000	15,600	1,845,600
1980	556,000	1,444,000	13,600	2,013,600
1981	570,000	1,501,000	12,600	2,083,600
1982	695,000	1,405,000	16,500	2,116,500
1983	728,000	1,633,000	32,000	2,393,000
1984	1,075,000	1,566,000	31,000	2,672,000
1985	934,000	1,637,000	35,000	2,606,000
1986	929,000	1,979,000	34,000	2,942,000
1987	914,000	1,924,000	34,000	2,872,000

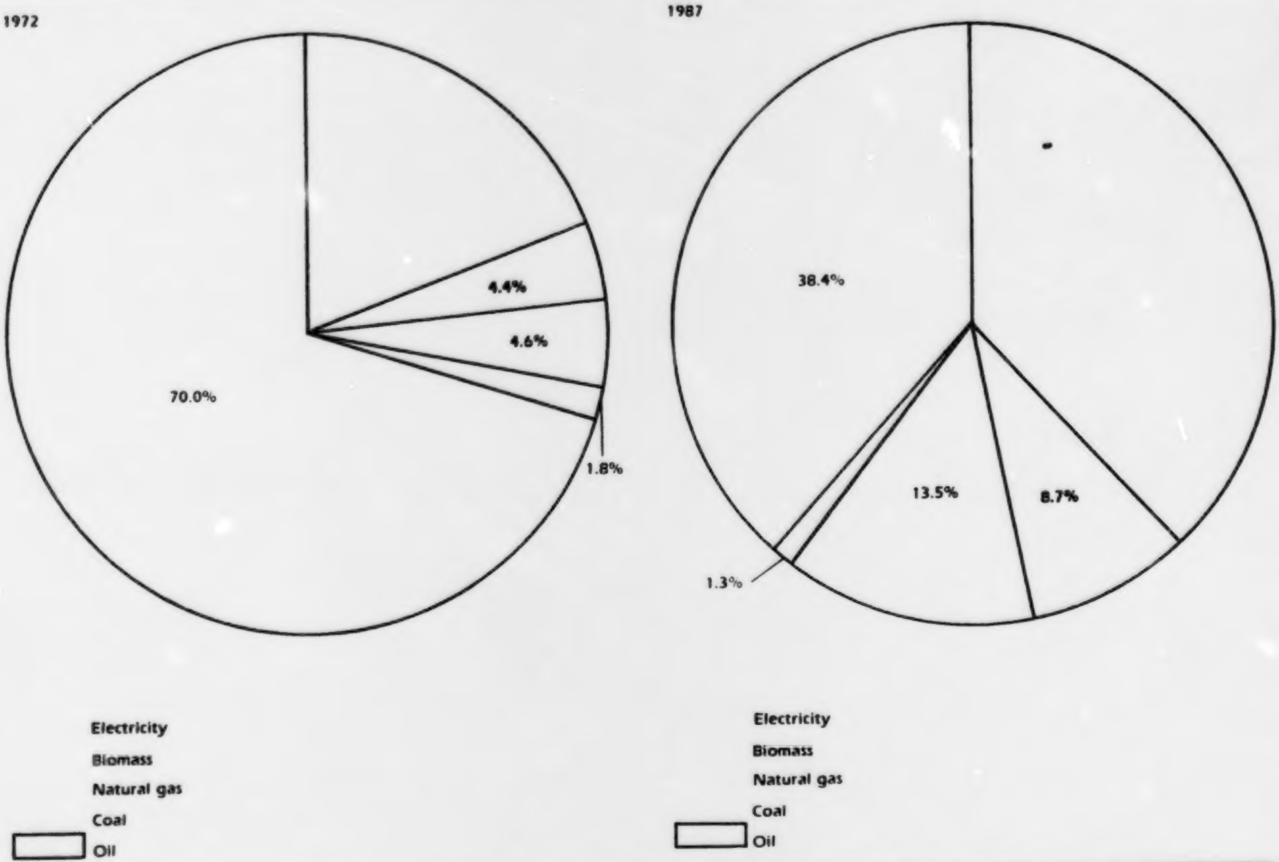
na: not available
Source: Direction des études et statistiques of the ministère de l'Énergie et des Ressources du Québec.

Graph 9.1

PROGRESS OF BIOMASS CONSUMPTION FOR ENERGY PURPOSES



QUÉBEC ENERGY CONSUMPTION, INCLUDING BIOMASS



APPENDIX 1

THE STRUCTURE OF ENERGY CONSUMPTION AND CONVERSION TABLES

An energy balance sheet is a set of numerical data giving an overall statistical picture, for a given period, of the various energy production, trade and transformation activities, from initial production to final consumption. An energy balance sheet groups together, in the form of a coherent and homogeneous presentation, relevant numerical data describing how the energy sector works.

The following is Québec's whole energy balance sheet for 1987. The energy balance sheet has been broken down into various parts in order to include a maximum of information. It must be read vertically. Each of the forms of energy concerned strictly complies with the balance of resources and requirements.

A horizontal grouping of numerical data follows these comprehensive tables, in order to show the total energy consumption by sector of utilization and by energy form.

Sources used

All the data listed are from Statistics Canada publications, mainly from catalogue 57-003. Additional sources are indicated at the bottom of the tables, where applicable.

Information provided by the energy balance sheet

The energy balance sheet describes the production, consumption and trade of 17 different energy products. These products have been grouped into four categories, according to their physical characteristics at the time of their final use:

- solid fuel (coal and coke);
- oil (crude oil gasoline, aviation gasoline, jet fuel, kerosene, diesel fuel, light fuel oil, heavy fuel oil, petroleum coke);
- gas (natural gas, coke-oven gas, propane and butane, still gas);
- electricity.

For each of these forms of energy, the energy balance sheet gives data for both the available resources and the utilization of these resources. Resource availability is determined by taking into account production, external trade, producer consumption and stock variations, for both primary and secondary energy.

For the utilization of available resources, the energy balance sheet gives the consumption breakdown for each sector (residential, commercial, transportation, industrial, and other uses). It should be noted that coke-oven gas does not appear in the energy balance sheet, as this form of energy has been neither produced nor consumed in Québec for several years.

Methodology

The main objective was to obtain homogeneous data. The same rules concerning the recording of losses, producer consumption and stock variations were therefore applied to all energy forms.

Considered as primary energy are all energy forms received in the raw state, before processing (coal, crude oil, natural gas, some propane and butane, electricity from hydraulic and nuclear sources). All energy forms that have undergone a transformation or have been processed are considered as secondary energy (coke and coke-oven gas derived from coal, all petroleum products), with the exception of certain propane and butane classified as primary energy.

The energy balance sheet indicates the portion of primary energy consumed directly and the transformation of primary energy transformed into secondary energy.

In addition, these tables list the primary and secondary energy that is not used: crude oil transformed into non-energy products (asphalt, petrochemical feedstock, lubricating oils and greases, naphtha, etc.), petroleum coke, propane and butane used for non-energy purposes.

Units of measurement

The energy balance sheet is in imperial units: short tons for solid fuel, barrels for petroleum products, thousands of cubic feet for natural gas and coke-oven gas, and thousands of kilowatt-hours for electricity. The thermal unit used to standardize the statistics for the different forms of energy is the BTU (British Thermal Unit).

Nevertheless, in order to keep up with the replacement of imperial units with metric units, certain data are also listed in metric units. In the actual energy balance sheet, these represent final data (total resources and total consumption), as well as complementary tables listing the net total energy available for Québec consumption and the breakdown of the total energy consumed by each sector.

One of the difficulties lays in the fact that the units used in Canada, within the international system, are very different from the metric units used by the European countries and by the OECD. As it seemed important to be able to easily compare Québec statistics with both OECD countries and with other provinces, the two current metric systems were used.

In the OECD metric system, data are expressed in tonnes for solid fuel and petroleum products, in thousands of therms for natural gas and coke-oven gas, and in thousands of kilowatt-hours for electricity. The thermal unit is the tonne oil equivalent (1 toe = 10^7 kcal or 10^4th).

In the international system adopted by Canada, data are expressed in tonnes for solid fuel, in cubic metres for petroleum and gas products, and in thousands of kilowatt-hours for electricity. The thermal unit is the joule, but the gigajoule (1 GJ = 10^9J) and the petajoule (1 PJ = 10^{15}J) are often used.

In the following pages, conversion tables provide equivalents for the systems used.

EQUIVALENCE TABLE FOR MAIN ENERGY UNITS

Basic units of measurement

	Imperial	International	OECD metric
Coal	short ton (tn)	tonne (t)	tonne (t)
Oil	barrel (b)	cubic meter (m³)	tonne (t)
Gas	cubic foot (ft³)	cubic meter (m³)	therms (th)
Electricity	watt-hour (Wh)	watt-hour (Wh)	watt-hour (Wh)
Thermal	BTU	joule (J)	toe

Definition

1 short ton	:	2,000 pounds
1 barrel	:	35 imperial gallons
1 cubic foot	:	volume of a cube with 1-foot sides
1 BCF	:	10^9 cubic feet
1 TCF	:	10^{12} cubic feet
1 watt-hour	:	power supplied by 1 watt for 1 hour
1 BTU	:	amount of heat needed to raise the temperature of 1 pound of water by 1 degree Fahrenheit
1 tonne	:	1,000 kilograms
1 cubic meter	:	volume of a cube with 1-meter sides
1 joule	:	amount of energy needed to lift 100 grams 1 meter off the ground
1 therm	:	amount of heat equal to 1 million calories
1 toe (10^7 kcal)	:	1 kilocalorie (kcal) is the amount of heat needed to raise the temperature of 1 kilogram of water by 1 degree centigrade

Prefixes for decimal multiples (metric system)

Exa	(E)	:	10^{18}
Peta	(P)	:	10^{15}
Tera	(T)	:	10^{12}
Giga	(G)	:	10^9
Mega	(M)	:	10^6
kilo	(k)	:	10^3
hecto	(h)	:	10^2
deca	(da)	:	10^1

	ELECTRICITY[1]	NATURAL GAS			OIL[2]				THERMAL ENERGY		
	kWh	**th**	**m³**	**ft³**	**t**	**m³**	**b/d***	**b**	**Toe**	**J**	**BTU**
BTU											
J											1.055×10^3
Toe										2.389×10^{-11}	2.520×10^{-8}
b									6.838	1.633×10^{-10}	1.723×10^{-7}
b/d*								2.740×10^{-3}	1.874×10^{-2}	4.475×10^{-13}	4.721×10^{-10}
m³							5.800×10^1	1.589×10^{-1}	1.087	2.596×10^{-11}	2.738×10^{-8}
t						8.447×10^{-1}	4.914×10^1	1.346×10^{-1}	9.206×10^{-1}	2.199×10^{-11}	2.320×10^{-8}
ft³					4.311×10^4	3.652×10^4	2.118×10^6	5.803×10^3	3.968×10^4	9.478×10^{-7}	1.000×10^{-3}
m³				2.833×10^{-2}	1.221×10^3	1.035×10^3	6.000×10^4	1.644×10^2	1.124×10^3	2.685×10^{-8}	2.833×10^{-5}
th			8.896	2.520×10^{-1}	1.086×10^4	9.202×10^3	5.338×10^5	1.462×10^3	1.000×10^4	2.389×10^{-7}	2.520×10^{-4}
kWh		1.163	1.035×10^1	2.931×10^{-1}	1.263×10^4	1.070×10^4	6.208×10^5	1.701×10^3	1.163×10^4	2.778×10^{-7}	2.931×10^{-4}
W (yr)	1.427×10^{-1}	1.660×10^{-1}	1.476	4.182×10^{-2}	1.803×10^3	1.527×10^3	8.858×10^4	2.427×10^2	1.660×10^3	3.964×10^{-8}	4.182×10^{-5}

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Transfer of a quantity of energy from one form to another is based on the thermal quality of each of the forms in question.

Example: 10^6 **BTU** $\times 1.055 \times 10^3 = 1.055 \times 10^9$ **J**

1.055×10^9 **J** $\div 1.055 \times 10^3 = 10^6$ **BTU**

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1. Energy is estimated at 3,412 BTU per kWh. Power is based on an annual production whose factor of utilization (U.F.) of installed capacity is 80%. When the U.F. is 60%, the power obtained with an 80% U.F. is multiplied by 1.333.
2. Canadian crude oil.

*: Per day in the calendar year.

CONVERSION TABLE FROM IMPERIAL SYSTEM TO OECD METRIC SYSTEM

Product	Imperial units	OECD metric units
SOLID FUELS		
Coal	1 short ton	0.90718 tonne
Coke	1 short ton	0.90718 tonne
OIL		
Canadian crude	1 barrel	0.1346 tonne
International crude	1 barrel	0.1366 tonne*
Aviation gasoline	1 barrel	0.1124 tonne
Gasoline	1 barrel	0.1173 tonne
Jet fuel	1 barrel	0.1261 tonne
Kerosene	1 barrel	0.1294 tonne
Diesel fuel	1 barrel	0.1340 tonne
Light fuel oil	1 barrel	0.1340 tonne
Heavy fuel oil	1 barrel	0.1502 tonne
Petroleum coke	1 barrel	0.1815 tonne
GAS		
Natural gas**	1,000,000 BTU	252 therms
Coke-oven gas**	1,000,000 BTU	252 therms
Liquefied petroleum gas	1 barrel	0.0847 tonne
Still gas	1 barrel of heavy fuel oil equivalent	0.1501 tonne
ELECTRICITY		
	1,000 kilowatt-hours	1,000 kilowatt-hours

* Average value. The equivalence varies between 0.1375 and 0.1358, depending on the density of crude oil.

** In OECD countries, the data on natural gas and coke-oven gas are usually expressed in thermal units.

CONVERSION TABLE FROM IMPERIAL SYSTEM TO INTERNATIONAL SYSTEM

Product	Imperial units	International metric units
SOLID FUELS		
Coal	1 short ton	0.90718 tonne
Coke	1 short ton	0.90718 tonne
OIL		
Canadian crude oil	1 barrel	0.15891 cubic meter
International crude oil	1 barrel	0.15892 cubic meter
Aviation gasoline	1 barrel	0.15891 cubic meter
Gasoline	1 barrel	0.15891 cubic meter
Jet fuel	1 barrel	0.15891 cubic meter
Kerosene	1 barrel	0.15891 cubic meter
Diesel fuel	1 barrel	0.15891 cubic meter
Light fuel oil	1 barrel	0.15891 cubic meter
Heavy fuel oil	1 barrel	0.15891 cubic meter
Petroleum coke	1 barrel	0.15891 cubic meter
GAS		
Natural gas	1 cubic foot	0.0283278 cubic meter
Coke-oven gas	1 cubic foot	0.0283278 cubic meter
Liquefied petroleum gas		
Propane	1 barrel	0.15873 cubic meter
Butane	1 barrel	0.15883 cubic meter
Still gas	1 barrel of heavy oil equivalent	0.15891 cubic meter
ELECTRICITY		
	1,000 kilowatt-hours	1,000 kilowatt-hours

Conversion into thermal units

As stated earlier, the energy balance sheet is a set of tables that are read vertically. For each form of energy studied, the numerical data can therefore be given in natural units — whether these units are in the imperial system, the OECD metric system or the international system.

On the other hand, for the complementary tables which accompany the energy balance sheet, the standardization of the various forms of energy can only be carried out if the different data expressed in natural units are converted beforehand into common units. All forms of energy, be they fuel, gasoline or electricity, can be defined in terms of the quantity of heat they produce; it is possible to determine through laboratory experiments the exact caloric potential of a unit of a given energy form. The common unit used to standardize the different forms of energy is therefore the thermal units, and the caloric potential of each product allows for the definition, for a given natural unit, of the conversion coefficient in thermal units.

Following, are the conversion coefficients adopted here, under each of the three systems of measurement used (imperial system, OECD metric system and international system). Within each of the systems, the coefficients are absolute equivalents among themselves, for a given product.

COEFFICIENTS FOR CONVERSION INTO THERMAL UNITS WITHIN THE IMPERIAL SYSTEM

Product	Natural unit	1,000,000 BTU (10^6)
SOLID FUELS		
Coal	1 short ton	from 12.4000 to 24.9000*
Coke	1 short ton	24.8000
OIL		
Crude oil	1 barrel	5.8030
Aviation gasoline	1 barrel	5.0505
Gasoline	1 barrel	5.2220
Jet fuel	1 barrel	5.4145
Kerosene	1 barrel	5.6770
Diesel fuel	1 barrel	5.8275
Light fuel oil	1 barrel	5.8275
Heavy fuel oil	1 barrel	6.2874
Petroleum coke	1 barrel	6.3852
GAS		
Natural gas	1,000 cubic feet (10^3)	1.0000
Coke-oven gas	1,000 cubic feet (10^3)	0.5000
Liquefied petroleum gas		
Propane	1 barrel	from 3.8425 to 4.0950**
Butane	1 barrel	from 4.0950 to 4.3103***
Still gas	1 barrel of heavy fuel oil equivalent	6.2874
ELECTRICITY		
	1,000 kilowatt-hours (10^3)	3.4120

* The conversion coefficient for coal is the weighted average of the conversion coefficients of the five types of coal used. These coefficients were revised in 1987:

Lignite	1 short ton	12.4000 × 10^6 BTU
Sub-bituminous	1 short ton	16.2000 × 10^6 BTU
Canadian bituminous	1 short ton	23.7000 × 10^6 BTU
Anthracite	1 short ton	23.8000 × 10^6 BTU
Imported bituminous	1 short ton	24.9000 × 10^6 BTU

** Since the thermal value of propane decreased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	4.0950 × 10^6 BTU
since 1979	3.8425 × 10^6 BTU

*** Since the thermal value of butane increased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	4.0950 × 10^6 BTU
since 1979	4.3103 × 10^6 BTU

COEFFICIENTS FOR CONVERSION INTO THERMAL UNITS WITHIN THE OECD METRIC SYSTEM

Product	Natural unit	toe (10^7 kcal)
SOLID FUELS		
Coal	1 tonne	from 0.34394 to 0.69303*
Coke	1 tonne	0.68890
OIL		
Canadian crude	1 tonne	1.08624
International crude	1 tonne	1.07030
Aviation gasoline	1 tonne	1.13273
Gasoline	1 tonne	1.12250
Jet fuel	1 tonne	1.08201
Kerosene	1 tonne	1.10586
Diesel fuel	1 tonne	1.09552
Light fuel oil	1 tonne	1.09552
Heavy fuel oil	1 tonne	1.05523
Petroleum coke	1 tonne	0.88660
GAS		
Natural gas	10^3 therms	0.1
Coke-oven gas	10^3 therms	0.1
Liquefied petroleum gas		
Propane	1 tonne	from 1.14268 to 1.21769**
Butane	1 tonne	from 1.21769 to 1.28179***
Still gas	1 tonne	1.05523
ELECTRICITY	10^3 kilowatt-hours	0.0859824

* The conversion coefficient for coal is the weighted average of the conversion coefficients of the five types of coal used. These coefficients were revised in 1987:

Lignite	1 tonne	0.34394 toe
Sub-bituminous	1 tonne	0.44909 toe
Canadian bituminous	1 tonne	0.65942 toe
Anthracite	1 tonne	0.66182 toe
Imported bituminous	1 tonne	0.69303 toe

** Since the thermal value of propane decreased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	1.21769 toe
since 1979	1.14268 toe

*** Since the thermal value of butane increased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	1.21769 toe
since 1979	1.28179 toe

COEFFICIENTS FOR CONVERSION INTO THERMAL UNITS WITHIN THE INTERNATIONAL SYSTEM

Product	Natural unit	GJ (10^9 J)
SOLID FUELS		
Coal	1 tonne	from 14.400000 to 29.000000*
Coke	1 tonne	28.841024
OIL		
Canadian crude	1 m^3	38.525989
International crude	1 m^3	38.523565
Aviation gasoline	1 m^3	33.530158
Gasoline	1 m^3	34.668742
Jet fuel	1 m^3	35.946746
Kerosene	1 m^3	37.689478
Diesel fuel	1 m^3	38.688644
Light fuel oil	1 m^3	38.688644
Heavy fuel oil	1 m^3	41.741910
Petroleum coke	1 m^3	42.391202
GAS		
Natural gas	10^3 m^3	37.242567
Coke-oven gas	10^3 m^3	18.621284
Liquefied petroleum gas		
Propane	1 m^3	from 25.53 to 27.217445**
Butane	1 m^3	from 28.62 to 27.200308***
Still gas	1 m^3	41.741910
ELECTRICITY		
	10^3 kWh	3.600000

* The conversion coefficient for coal is the weighted average of the conversion coefficients of the five types of coal used. These coefficients were revised in 1987:

Lignite	1 tonne	14.400000 GJ
Sub-bituminous	1 tonne	18.800000 GJ
Canadian bituminous	1 tonne	27.600000 GJ
Anthracite	1 tonne	27.700000 GJ
Imported bituminous	1 tonne	29.000000 GJ

** Since the thermal value of propane decreased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	27.217445 GJ
since 1979	25.53 GJ

*** Since the thermal value of butane increased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	27.200308 GJ
since 1979	28.62 GJ

COEFFICIENTS FOR CONVERSION FROM THE INTERNATIONAL SYSTEM INTO OECD METRIC SYSTEM

Product	Natural unit	toe (10^7 kcal)
SOLID FUELS		
Coal	1 tonne	from 0.34394 to 0.69303*
Coke	1 tonne	0.68890
OIL		
Canadian crude	1 m^3	0.9202416
International crude	1 m^3	0.9201837
Aviation gasoline	1 m^3	0.8009099
Gasoline	1 m^3	0.8281064
Jet fuel	1 m^3	0.8586331
Kerosene	1 m^3	0.9002605
Diesel fuel	1 m^3	0.9241268
Light fuel oil	1 m^3	0.9241268
Heavy fuel oil	1 m^3	0.9970579
Petroleum coke	1 m^3	1.0125671
GAS		
Natural gas	10^3 m^3	0.8895854
Coke-oven gas	10^3 m^3	0.4447927
Liquefied petroleum gas		
Propane	1 m^3	from 0.6098161 to 0.6501228**
Butane	1 m^3	from 0.6497135 to 0.6836246***
Still gas	1 m^3	0.9970579
ELECTRICITY	10^3 kWh	0.0859824

* The conversion coefficient for coal is the weighted average of the conversion coefficients of the five types of coal used. These coefficients were revised in 1987:

Lignite	1 tonne	0.34394 toe
Sub-bituminous	1 tonne	0.44909 toe
Canadian bituminous	1 tonne	0.65942 toe
Anthracite	1 tonne	0.66182 toe
Imported bituminous	1 tonne	0.69303 toe

** Since the thermal value of propane decreased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	0.6501228 toe
since 1979	0.6098161 toe

*** Since the thermal value of propane decreased from 1958 to 1979, a variable conversion factor has been adopted:

from 1958 to 1978	0.6497135 toe
since 1979	0.6836246 toe

Gouvernement du Québec
Ministère de l'Énergie
et des Ressources